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Trends in ACT Mathematics and Science Reasoning Achievement, Curricular Choice, and Intent for College Major: 1995–2000

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Abstract

This study examined trends in student achievement on the ACT Mathematics and Science Reasoning tests, as well as trends in percentages of students taking a core curriculum and expressing an intent to major in a mathematics- or science-related field. The data on which analyses were conducted consisted of all valid records for U.S. public high school students who graduated in the years 1995 through 2000.

Statistics used in the analyses of trends were descriptive in nature, and included means, standard deviations, percentages, and effect sizes. Findings indicated little consistent change in student achievement on ACT Mathematics and Science Reasoning tests for U.S. students graduating from high school in years 1995 through 2000. However, there was a slight increase in the percentage of students taking a core curriculum, as well as in the percentage of students intending to major in a mathematics- or science-related field. Students taking a core curriculum outperformed non-core takers on average, as did intended mathematics- or science-related majors relative to intended non-majors.

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Introduction

President Ronald Reagan (cited in NCEE, 1983) observed that "[c]ertainly there are few areas of American life as important to our society, to our people, and to our families as our schools and colleges." Education was noted as the foundation for a satisfying life, an enlightened and civil society, a strong economy, and a secure nation. However, given the state of the U.S. educational system in 1983, America was at risk (NCEE, 1983).

Commissioned in 1981, the National Commission on Excellence in Education (NCEE) examined the quality of education in the United States. The result of the inquiry was presented in the landmark document *A Nation at Risk* (NCEE, 1983). To say that America was at risk due to educational problems is understating the conclusions presented in *A Nation at Risk.* The report suggests that should an unfriendly power impose such educational mediocrity on our children, it would be considered an "act of war."

Rather than simply criticize the American educational system, the authors of *A Nation at Risk* recommended a number of improvements. Of particular importance to the present study was the recommendation that students take a core curriculum in high school. The recommendation stated that state and local high school graduation requirements must be strengthened. At a minimum, all students seeking a diploma must lay the foundations in the *Five New Basics* by taking the following [core] curriculum during their four years of high school:

1. four years of English;
2. three years of mathematics;
3. three years of science;
4. three years of social studies; and

5. one-half year of computer science.

It was also strongly recommended that college-bound students take two years of foreign language in high school (NCEE, 1983).

Along with those presented in *A Nation at Risk,* other negative evaluations of education in the United States helped motivate a number of educational and political initiatives intended to address the lack-luster performance of the educational system. These initiatives culminated in the *Goals 2000: Educate America Act* (H. R. 1804, 1994). This act represented an attempt to "improve student learning through a long-term, broad-based effort to promote coherent and coordinated improvements in the system of education throughout the Nation at the State and local levels" (Goals 2000: Educate America ACT, 1994; Title III, Section 302).

The literature review of this study will describe Goals 2000 in more detail. Within this discussion, emphasis will be placed on Goal 5 and two of its three objectives. Goal 5 states that "By the year 2000, United States students will be first in the world in mathematics and science achievement" (Goals 2000: Educate America Act, 1994; Sec. 102). An underlying rational for this goal was that to ensure a competitive workforce that had the necessary technical and scientific skills to fulfill responsibilities inherent in a global economy, the math and science skills of *all* students in the United States had to be developed to their fullest (National Education Goals Panel (NEGP), 1997).

The National Commission on Mathematics and Science Teaching for the 21st Century (2000) supported the goal of international mathematics and science competency and excellence. They identified four key reasons for their stance:

1. "the rapid pace of change in both the increasingly interdependent global economy and in the American workplace demands widespread mathematics- and science-related knowledge and abilities;"

2. "our citizens need both mathematics and science for their everyday decision-making;"
3. "mathematics and science are inextricably linked to the nation's security interests;"
4. "the deeper, intrinsic value of mathematical and scientific knowledge shape and define our common life, history, and culture" (p. 1).

Pursuit of proficiency and excellence in mathematics and science requires commitment of time and resources. As such, evidence must be put forth to determine the degree to which goals and objectives are being achieved. Failure to obtain such evidence could render pursuit of educational goals, such as Goal 5, nothing more than useless rhetoric and wasteful expense in the eyes of the American people. Consequently, educational researchers must keep tabs on national progress towards Goals 2000, and in particular, Goal 5.

The purpose of the present study was to add to the body of evidence describing what changes in American high school student mathematics achievement, science achievement, and related education have taken place since the inception of Goals 2000. This study was intended to describe trends in U.S. public high school student achievement as measured by ACT Mathematics and ACT Science Reasoning scores from 1995 to 2000. Furthermore, it intended to describe trends in percentages of students taking college preparatory core curricula and intending to major in a mathematics- or science-related field from 1995 through 2000.

Literature Review

A Brief History of Goals 2000

In the early 1980's, Secretary of Education T. H. Bell observed a need to examine the quality of the educational system in the United States. His suspicion was that serious problems existed within the structure. In response to this suspicion, he created the National Commission on Excellence in Education (NCEE) in 1981.

The NCEE was charged with six general tasks:

1. Assessing the quality of teaching and learning in American public and private schools, colleges, and universities;
2. Conduct comparisons of the American educational institutions to those in other developed countries;
3. Investigate the relationship between college admissions requirements and high school achievement;
4. Identify successful educational programs for college students;
5. Assess the degree to which recent social and educational changes have influenced student achievement;
6. Define problems to face and overcome when pursuing excellence in education (NCEE, 1983).

Though selective attention was given to elementary, vocational, technical, and higher education, the commission's primary focus was on high schools. Guided by the aforementioned tasks, the Commission began the arduous task of investigating the condition of education in the U.S.

By using a wide range of informational sources (e.g., papers commissioned by experts, letters from concerned citizens, panel discussions, etc.), the NCEE attempted to get as complete a picture of the American educational system as time and resources permitted. The commission came to the conclusion, "Our Nation is at risk." ... Furthermore, "If an unfriendly foreign power had attempted to impose on America the mediocre educational performance that exists today, we might well have viewed it as an act of war" (NCEE, 1983; p.5). This conclusion could not be taken lightly. After all, education is a cornerstone of America's economic, social, and national security.

Educational foundations were eroding, and with increased mediocrity in attitudes, the future of the nation and its people was threatened. America was at risk—at risk of failing to provide for its people (NCEE, 1983). Many factors were identified as indicators of risk. Key among these were:

1. International comparisons of student achievement in 1971 showed that on 19 academic tests, American students were never 1st or 2nd relative to other industrialized nations, and were last 7 times;

2. An estimated 23 million adults were functionally illiterate;

3. About 13% of all 17-year-olds could be considered functionally illiterate, with minority youth running as high as 40%;

4. Average achievement of high school students on most standardized tests had dropped over the previous 26 years;

5. Over 50% of the population of gifted students did not match their tested ability with comparable achievement in school;

6. SAT scores demonstrated a virtually unbroken decline from 1963 to 1980;

7. Business and military leaders complained that they were required to spend millions of dollars on costly remedial education and training programs in basic skills;

8. For the first time in the history of the U.S.A., the educational skills of one generation would not surpass, equal, or even approach those of their parents;

9. The average graduate of schools and colleges was not as well educated as the average graduate of 25 to 35 years previous (NCEE, 1983).

The NCEE (1983) report made five general recommendations to address problems within the American educational system. Recommendations were supplemented by suggestions on how to implement them. Several of the suggestions directly pertain to the present study. Pertinent suggestions included content considerations (e.g., students should take the core coursework mentioned earlier) and the adoption of more rigorous and measurable standards (e.g., administer standardized achievement tests at transition points from one level of schooling to another).

The various recommendations made in *A Nation at Risk*, as well as in subsequent documents urging educational reform, caused a great deal of concern among local, state, and federal officials. President Bush convened a national education summit in 1989 where he and Governors of the 50 U.S. states generated national education goals. In addition, they established local and state level initiatives to reach their goals (e.g., assessment reforms, monies for professional development, monies for pre-service teacher education, etc.; US Dept of Education, 1998).

Goals 2000: Educate America Act

President Bush's educational goals laid the groundwork for the proposal and ratification of the *Goals 2000: Educate America Act*, which passed in 1994 (H. R. 1804). Goals 2000 had several distinguishing characteristics. The Act:

1. Urged states to raise academic standards for students;
2. Was the first federal program to facilitate state and local cooperation in reform, rather than creating separate programs;
3. Provided incentives for reform at the school, community, and state levels;
4. Provided funds to states and schools earmarked for teacher training and professional development;
5. Encouraged parental involvement in education; and
6. Provided flexibility to states and local districts when implementing improvements (U.S. Department of Education, 1996).

The aforementioned characteristics were embodied in eight national educational goals:

1. "By the year 2000, all children in America will start school ready to learn" (H. R. 1804, Sect. 102.1.A, 1994);
2. "By the year 2000, the high school graduation rate will increase to at least 90%" (H. R. 1804, Sect. 102.2.A, 1994);
3. "By the year 2000, all students will leave grades 4, 8, and 12 having demonstrated competency over challenging subject matter including English, mathematics, science, foreign languages, civics and government, economics, arts, history, and geography, and every school in America will ensure that all students learn to use their minds well, so that they may be prepared for responsible citizenship, further learning, and productive employment in our Nation's modern economy" (H. R. 1804, Sect. 102.3.A, 1994);

4. "By the year 2000, the Nation's teaching force will have access to programs for the continued development of their professional skills and the opportunity to acquire the knowledge and skills needed to instruct and prepare all American students for the next century" (H. R. 1804, Sect. 102.4.A, 1994);

5. **"By the year 2000, United States students will be first in the world in mathematics and science achievement" (H. R. 1804, Sect. 102.5.A, 1994);**

6. "By the year 2000, every adult American will be literate and will possess the knowledge and skills necessary to compete in a global economy and exercise the rights and responsibilities of citizenship" (H. R. 1804, Sect. 102.6.A, 1994);

7. "By the year 2000, every school in the United States will be free of drugs, violence, and the unauthorized presence of firearms and alcohol and will offer a disciplined environment conducive to learning" (H. R. 1804, Sect. 102.7.A, 1994); and

8. "By the year 2000, every school will promote partnerships that will increase parental involvement and participation in promoting social, emotional, and academic growth of children" (H. R. 1804, Sect. 102.8.A, 1994).

These goals were clearly very broad, but each was accompanied by more detailed objectives. This study addressed the general statement of Goal 5, as well as objectives one and three below:

1. Goal 5, Objective 1: Mathematics and Science Education Will Be Strengthened Throughout the Educational System;

2. Goal 5, Objective 2: The number of teachers with a substantive background in mathematics and science, including the metric system of measurement, will increase by 50 percent (This objective was not addressed by the present study.); and

3. Goal 5, Objective 3: The number of U.S. graduate and undergraduate students completing degrees in mathematics, science, or engineering will increase.

Both the National Education Goals Panel report (NEGP, 1997) and the National Commission on Mathematics and Science Teaching for the 21st Century report (2000) noted that Goal 5 was important due to the role that mathematics and science play in ensuring a workforce and population that can successfully function and compete in an increasingly technological workplace, as well as in a global economy.

One purpose of the present study was to gain a better understanding of whether the American educational system has improved its preparation of students in mathematics and science relative to a domestic standard. Evidence arising from this investigation spoke indirectly to the general statement of Goal 5.

The three objectives for Goal 5 presented above guided evaluation of its degree of attainment. A strengthened mathematics and science educational system, as referenced in the first objective, will be investigated by comparing frequency of and achievement by students who took or intended to take a core course sequence to those who did not. A core course sequence, as defined by ACT (1997), closely parallels the recommendation made in *A Nation at Risk* (NCEE, 1983): a core course sequence represents "at least four years of English, and at least three years each of mathematics, social studies, and natural sciences" (ACT, 1997; p. 39).

As stated earlier, objective two was not addressed. The 3rd objective of Goal 5 listed above was indirectly investigated in terms of trends in percentage of high school students who were "Fairly Sure" or "Very Sure" that they would major in a mathematics- or science-related field in college. Note, however, that these students were not *actual* majors, but *intended* majors.

Explicit in Goal 5 is the notion that mathematics and science achievement by American students would surpass every other nation in the world by the year 2000. The present study was intended to speak not to U.S. student achievement relative to an international reference group, but to compare performance of American students across years 1995-2000.

When looking at domestic trends, one must consider how domestic trends relate to international standing. In *Youth at the Crossroads*, Barth, Haycock, Huang, and Richardson (2001) characterized the U.S. educational system as an object at rest in a world rushing by. This characterization suggested that, though achievement changes relative to a domestic reference group do not necessarily translate into changes in international standing, positive change relative to a domestic standard would suggest that American students might not be "rushed by" as quickly as would otherwise be the case. In order to determine what changes, if any, have occurred in achievement, this study will assess trends in ACT Mathematics and ACT Science Reasoning scores.

To better understand the domestic and global contexts in which high school/secondary school mathematics and science achievement levels are compared, results from both international and domestic assessments must be examined. The following assessments were chosen to describe international and domestic contexts: the Third International Mathematics and Science Study (TIMSS) *Mathematics and Science Literacy Test* and the National Assessment of Academic Proficiency (NAEP) *Long Term Assessment*. Aspects of each spoke to longitudinal comparisons of U.S. students, either from an international or domestic perspective.

International Achievement: TIMSS

A discussion of international results from the Third International Mathematics and Science Study (TIMSS) will help put dialogue regarding Goal 5 into perspective. Conducted by the International Association for the Evaluation of Educational Achievement (IEA), TIMSS was designed for use in providing policy makers, educators, researchers, and practitioners with information about education and learning (Mullis, Martin, Beaton, Gonzalez, Kelly, & Smith, 1998). TIMSS results represented three educational levels (i.e., 4^{th} graders, 8^{th} graders, and students at the end of their secondary school experience), assessed more than 500,000 students from 41 countries, and collected data in 30 different languages. Results of primary interest for the present study described the achievement of students in their final year of secondary school. Nearly all students were assessed at the end of the 1994-1995 school year.

Three main TIMSS tests were given to final-year students. Of the three tests, the one most relevant to the present study was the Mathematics and Science Literacy test. It was designed to assess mathematics and science learning for all students in their final year of secondary school, regardless of school curriculum (Mullis et al., 1998). Its intent was to provide information about how prepared graduates were to solve mathematics and science problems and deal with mathematics and science in the real world. These results were also compared to previous international studies (e.g., IEA mathematics studies in 1974 and 1980-1982, and IEA science studies in 1970-1971 and 1983-1984).

Bohrnstedt (1997) argued that four key conditions must be met for valid comparison and interpretation of international achievement trends:

1. Content frameworks must be common across time;
2. Items must validly measure subareas and themes within content frameworks;
3. Identical sampling rules and procedures must be used across time; and
4. The same population must be compared across time.

Bohrnstedt charged that these criteria are not often met in their entirety when comparing results on international assessments. For instance, TIMSS assessed potentially different populations compared to previous secondary school achievement studies. The reason for this was that the degree of attention paid to obtaining a representative sample from each nation involved with TIMSS was not attended to in earlier studies (Beatty, Paine, & Ramirez, 1999). So, when making unqualified comparisons of below average American student achievement on TIMSS to achievement on international assessments from other points in time, criticism would be drawn on the basis of inferences being directed toward dissimilar populations.

Similar problems occur even with studies that use data from only one point in time. TIMSS *Population 3* results (i.e., students completing secondary school) used in cross-nation comparisons are potentially misleading. Specifically, ages and numbers of years of schooling differed as a function of national educational systems. As such, some argue that this differential preparedness makes for unfair comparisons between nations. Designers of TIMSS, however, argued that the most useful results would be in describing students who were at the end of secondary education and were on the brink of entering postsecondary education or the workforce (Beatty, Paine, & Ramirez, 1999). Given their purpose, the manifestation of differential preparedness spoke directly to the line of inquiry addressing how much education/training students receive before they move beyond secondary school.

General results for the Mathematics and Science Literacy Tests are presented in Table 1 (NCES, 1999).

TABLE 1

U.S. TIMSS Performance for the Final Year of Secondary School Relative to Other Countries

	General Mathematics Knowledge	General Science Knowledge	
Nation[1]	Performance Relative to the United States	Performance Relative to the United States	Sampling Guidelines Adherence
Australia	Significantly Higher	Significantly Higher	No
Austria	Significantly Higher	Significantly Higher	No
Canada	Significantly Higher	Significantly Higher	No
Cyprus	***Significantly Lower***	***Significantly Lower***	No
Czech Republic	*Not Significantly Different*	*Not Significantly Different*	Yes
Denmark	Significantly Higher	Significantly Higher	No
France	Significantly Higher	*Not Significantly Different*	No
Germany	Significantly Higher	*Not Significantly Different*	No
Hungary	Significantly Higher	*Not Significantly Different*	Yes
Iceland	Significantly Higher	Significantly Higher	No
Italy	*Not Significantly Different*	*Not Significantly Different*	No
Lithuania	*Not Significantly Different*	*Not Significantly Different*	No
Netherlands	Significantly Higher	Significantly Higher	No
New Zealand	Significantly Higher	Significantly Higher	Yes
Norway	Significantly Higher	Significantly Higher	No
Russian Federation	*Not Significantly Different*	*Not Significantly Different*	No
Slovenia	Significantly Higher	Significantly Higher	No
South Africa	***Significantly Lower***	***Significantly Lower***	No
Sweden	Significantly Higher	Significantly Higher	Yes
Switzerland	Significantly Higher	Significantly Higher	Yes

[1]Nations are arranged in alphabetical order

In order to ensure that comparable groups of students were assessed from each country, a detailed set of sampling guidelines was devised. However, only 5 out of 21 countries with students taking the TIMSS Mathematics and Science Literacy Tests adhered to these sampling guidelines. Bearing this caveat in mind, TIMSS results showed that U.S. students outperformed students from Cyprus and South Africa on both general mathematics knowledge and general science knowledge. In mathematics, U.S. students scored at the same level as 4 other nations, and scored at the same level as 7 other nations in science. In other words, the U.S. was ranked in the bottom 7 countries out of 21 tested in mathematics and the bottom 10 out of 21 tested in science. Even when looking only at the performance of the top 25% of students in each country's entire school-leaving age cohort, the U.S. was not among the top countries (Mullis, et al., 1998).

Comparing across content areas, U.S. students demonstrated relatively higher achievement in science literacy than in mathematics literacy. Within U.S. results, males tended to outperform females in science literacy, but there was no meaningful difference between male and female performance in mathematics literacy (Mullis, et al., 1998).

A discussion of TIMSS Physics and Advanced Mathematics tests will not be undertaken. These tests were designed to assess students with a background in physics and advanced mathematics coursework, respectively. Because of the dissimilarity in the purpose of these tests compared to that of the ACT Assessment, achievement on these tests is not germane to the purpose of the present study.

Domestic Achievement: NAEP

Results from the National Assessment of Educational Progress (NAEP) Long Term Assessment were chosen to broaden the interpretive context for domestic trends. This assessment was designed to measure student progress over time. As such, the instrument has remained substantially the same since its first administration in 1969 (Campbell, Hombo, & Mazzeo, 2000).

Although the NAEP Long Term Assessment was administered to 9-, 13-, and 17-year-old students, the focus of the present study necessitates highlighting results from 17-year-old students only. This focus was decided for reasons of parallelism in educational experiences between the group of 17-year-old students who take NAEP and students who generally take the ACT Assessment (generally 16-18 years old).

The NAEP Long Term Assessment is composed of three content area tests and a student background questionnaire:

1. Reading test: composed of both multiple choice and constructed response items. It is designed to assess student reading proficiency in the context of studies, poems, essays, reports, textbook passages, and the like (Campbell, et al., 2000);

2. Mathematics test: most mathematics items are of multiple choice format. They assess such areas as knowledge of basic mathematical facts, geometric measurement formulas, and proficiency in carrying out numerical algorithms and applying mathematics to daily-living skills (Campbell, et al., 2000);

3. Science test: addresses student content knowledge and cognitive capabilities relevant to problem solving and science in general (Campbell, et al., 2000). The science test employs only multiple choice items; and

4. Background questionnaire: provides a wealth of personal data on students within the sample. This background information was related to student home and school experiences that were thought to relate to educational achievement.

To permit broad applicability of results, samples for Long Term NAEP studies were drawn with intent to make them representative of the nation as a whole.

Based on NAEP Long Term mathematics and science results, a number of trends could be determined that were germane to the present study. Note that reading results are not discussed because reading content is not relevant to this study.

When considering the performance of all 17-year-olds in mathematics:

1. Declining performance trends between 1973 and 1982 were reversed in the mid-to-late 1980's and early 1990's;

2. After 1990, the rate of increase slowed; and

3. In 1999, average mathematics scores surpassed those of 1973, and the average score in each quartile range surpassed those in 1978 (Campbell, et al., 2000).

When considering the performance of all 17-year-olds in science:

1. Declining performance between 1969 and 1982 had reversed, with performances increasing through 1992;

2. Since 1992, the performance has neither increased nor decreased appreciably;

3. The average score in 1999 was higher than those in years 1977 through 1990, but was still lower than the 1969 average; and

4. Long Term NAEP average science scores increased between 1977 and 1999 in the top three quartiles, but not in the lower one (Campbell et al., 2000).

Common to Goal 5 of Goals 2000, a point of interest in the use of NAEP Long Term Assessment data was course-taking patterns (Campbell, et al., 2000). In 1999, a greater percentage of 17-year-olds took such courses as Algebra II, Calculus, Pre-Calculus, and other advanced math courses than did in 1978. This percentage increase in students taking Algebra II manifested itself in Hispanic, Black, and White student data. However, only White students showed a significant increase in the percentage taking Pre-Calculus or Calculus (Campbell, et al., 2000).

Science course taking among 17-year-olds increased between the years 1986 and 1999. This increase was observed at all levels of coursework (Campbell, et al., 2000). The percentage of White students taking courses at each level of science coursework increased between 1986 and 1999. The percentage of Black and Hispanic students taking chemistry and Black students taking biology also increased since 1986.

In summarizing results from NAEP and TIMSS, several themes emerged:

1. Achievement levels of U.S. students in mathematics and science had reached a plateau or demonstrated only a slight increase relative to domestic criteria;

2. There seemed to have been an increase in student basic and/or advanced course-taking in the fields of mathematics and science; and

3. U.S. students did not appear to have attained pre-eminence in mathematics and science relative to international criteria.

Domestic Achievement: ACT

ACT scores and course-taking patterns have been found to be an important predictor of success in postsecondary mathematics and science studies. McClure, Sun, and Valiga (1997) investigated student performance on ACT Composite and Mathematics scores and student course-taking patterns. McClure et al. (1997) observed that when one looks at the total group averages, ACT Composite and Mathematics scores increased by 0.2 and 0.3 scale score points, respectively, between the years 1987 and 1996. The investigation by McClure et al. also identified changes in course-taking patterns. Percentages of students taking advanced mathematics and science coursework (e.g., Algebra II, Geometry, Trigonometry, Calculus, Other Math, Chemistry, and Physics) steadily increased between the years 1987 and 1996, with increases ranging from 5% to 13% (McClure et al., 1997).

While much information has been gleaned from TIMSS (pre-1996), NAEP (to present), and ACT (pre-1997), a more complete picture of secondary school achievement trends would include recent ACT data (1995 to present). The nature of ACT data is such that it does not permit direct international comparisons. Furthermore, this study makes no assumption that the ACT Assessment Mathematics and Science Reasoning tests measure completely parallel constructs to those assessed in TIMSS and NAEP mathematics and science tests. However, the use of ACT Mathematics and Science Reasoning scores permits addressing another slant on U.S. mathematics and science achievement trends. Presumably, if our students are moving forward relative to a domestic criterion (e.g., compared to students in previous years on similar instruments), they may also be better off at the international level than they would otherwise be.

Using the ACT Assessment

Assessing change in achievement levels of secondary U.S. students over time is well served by the use of a standardized instrument such as the ACT Assessment. The assessment provides a common metric against which to compare students from different years. One should note, however, that even with such a standardized metric, changes in the compositions of populations defined as all public school ACT Assessment examinees in given years permits the introduction of extraneous variables into the system that can increase the difficulty of interpretation.

The ACT Assessment is composed of four tests of educational development (e.g., Mathematics, Science Reasoning, Reading, and English) designed to "measure, as directly as possible, the academic skills that students need to perform college level work" (ACT, 1997; p.1). By investigating Mathematics and Science Reasoning performance trends on the ACT Assessment, we get a glimpse of changes in overall student preparedness to perform college level mathematics and science.

As part of the application procedure for taking the ACT Assessment, students are asked to indicate courses that they have taken or plan to take. Should a student indicate that he/she has taken or plans to take at least four years of English, and three years each of mathematics, science, and social studies before graduation, he/she is described as taking a college preparatory core course sequence (ACT, 1997). Coursework taken, as indicated by information in the ACT Assessment application materials, particularly in fields of mathematics and science, has been shown to be related to performance on the ACT Assessment (Noble, Davenport, Schiel, & Pommerich, 1999; Noble & McNabb, 1989).

Higher percentages of students completing a core curriculum can be argued to be movement toward attaining Goal 5. This point of view is based on the fact that:

1. the ACT Assessment provides valid scores for measuring student preparedness for college; and
2. taking a core curriculum is positively associated with increases in ACT Assessment scores.

These statements imply that increased core course taking, especially in mathematics and science, is positively related to student preparedness for college. In other words, increased core course-taking such as the core defined above is associated with increased student achievement through improved educational preparation for life beyond high school, which translates into a better chance for achieving international excellence in mathematics and science.

Applicants for the ACT Assessment also indicate their intended college major. Students indicating that they are "Fairly Sure" or "Very Sure" of their intent to major in a mathematics- or science-related field were considered intended mathematics- or science-related majors for the purposes of this study. One should note, however, that intent to major in a given field does not necessarily translate into completion of that major. While percentages of students who are very sure that they will pursue a major in a mathematics- or science-related field do not represent *all* students referred to in the third objective of Goal 5 (i.e., the number of students graduating with a degree in mathematics and/or science will increase), the major indicator can help identify students starting their college careers as intended mathematics- or science-related majors.

Results based on student ACT Mathematics and Science Reasoning scores for graduates from years 1995 to 2000 will serve to broaden the understanding of educational trends leading up to the year 2000. Thus, this study specifically addressed the following questions:

For *public* high school graduates from years 1995 through 2000,

1. Was there any change in student mathematics and science achievement as measured by ACT Mathematics and ACT Science Reasoning tests?
   - If the overall population were divided on the basis of whether students took a college preparatory curriculum in high school, would the groups exhibit different achievement trends over time?
   - If the overall population were divided on the basis of whether they intended to pursue a college major in a mathematics- or science-related field or not, would the groups exhibit different achievement trends over time?

2. Has there been any change in the percentage of students taking a college preparatory curriculum?

3. Has there been any change in the percentage of students who are "Fairly Sure" or "Very Sure" that they will major in a math- or science-related field?

Methods

Data

Data were obtained from ACT Assessment Program history files for public high school students indicating a graduation year between 1995 and 2000, inclusive. Student records representing the most recent testing of examinees that graduated from public high schools were used in this study. Only public school data were used because much of the funding provided in pursuit of Goal 5 went to state and local educational systems.

Table 2 shows that the number of public high school students with complete records for graduation years 1995-2000 ranged from 767,987 in 1995 to 864,201 in 2000. Of these, between 617,053 and 679,091 indicated that they were "Fairly" or "Very" sure that they would major in one of the college major choices listed in the ACT Assessment *Student Profile Section* of the Student Information booklet.

TABLE 2

Frequency of Examinees by Variable per Graduation Year

	Graduation Year					
Variable Category	1995	1996	1997	1998	1999	2000
			Curriculum Type			
Core	449,791	459,804	475,107	505,789	512,841	537,462
	58.6%	59.7%	60.2%	62.3%	61.7%	62.2%
Non-Core	312,517	305,521	308,644	300,615	312,564	319,073
	40.7%	39.7%	39.1%	37.0%	37.6%	36.9%
Missing	5,679	4,753	4,994	5,379	5,871	7,666
	0.7%	0.6%	0.6%	0.7%	0.7%	0.9%
Total	767,987	770,078	788,745	811,783	831,276	864,201
			"Fairly" or "Very" sure of Intended College Major			
Mathematics/Science-Related	111,101	111,562	117,190	122,179	127,995	133,035
	18.0%	18.1%	18.5%	18.9%	19.5%	19.6%
Non-Mathematics/Science-Related	505,952	504,912	517,773	525,810	529,140	546,056
	82.0%	81.9%	81.5%	81.1%	80.5%	80.4%
Total	617,053	616,474	634,963	647,989	657,135	679,091

Instruments

ACT Assessment Mathematics and Science Reasoning scores were used as indicators of mathematics and science achievement. The ACT Assessment is composed of four major parts:

1. Tests of Educational Development;
2. Student Profile Section;
3. High School Course/Grade Information Section; and
4. The Unisex Edition of the ACT Interest Inventory (UNIACT).

The first part of the ACT Assessment germane to this study is composed of the ACT Assessment Tests of Educational Development. There are five educational development scores provided – English, Reading, Science Reasoning, Mathematics, and Composite scores. The Tests of Educational Development are designed to "measure skills that are acquired in secondary education and that are most important for success in postsecondary education" (ACT, 1997; p. 4).

The Mathematics test is a 60-item test designed to assess mathematical reasoning skills typically acquired in U.S. secondary schools through the beginning of grade 12. The Science Reasoning test is a 40 item test designed to measure interpretation, analysis, evaluation, reasoning, and problem-solving skills required in the natural sciences (ACT, 1997). Because this study focused on mathematics and science, scores on the other achievement tests and the composite score are not discussed here.

The second part of the ACT Assessment germane to this study was the *Student Profile Section (SPS).* This section is based on the premise that "the quality of education a college provides depends, in part, on the amount of relevant information its staff has about its students, and that educational quality rises when this information is available in a systematic form prior to enrollment" (ACT, 1997; p. 93). The SPS provides self-reported student information in 11 general categories. Of particular interest to the present study was the *Educational Plans, Interests, and Needs* section, because students were asked to indicate the field in which they intend to major when in college, as well as how sure they are that they would pursue that major (i.e., "Not Sure", "Fairly Sure", or "Very Sure").

The final portion of the ACT Assessment germane to this study was the high school *Course Grade Information Section* (CGIS). Students registered for national test dates indicated whether they have taken, are currently taking, or will take any of thirty different high school courses, all categorized within the content areas of English, mathematics, natural sciences, social studies, languages, or arts. Based on this information, students are then classified according to whether they have completed or intend to complete a college-preparatory core curriculum by the time they graduate from high school.

The *Unisex Edition of the ACT Interest Inventory* (UNIACT) will not be discussed here. The valuable information that arises from students filling out the UNIACT does not facilitate answering the research questions of the present study.

Analyses

Analyses performed in this study were descriptive in nature. Due to the large sample sizes involved, and the fact that this study involved nearly every public school graduate between 1995 and 2000 that had a valid ACT Assessment record, inferential statistics were not employed. Means and standard deviations were supplemented by effect sizes to provide additional meaning for the results.

Effect sizes were computed by dividing the difference between means by the standard deviation of the differences (see Equation 1).

$$ES_{ij} = \frac{\overline{X}_i - \overline{X}_j}{\sqrt{\frac{n_i \bullet S_i^2 + n_j \bullet S_j^2}{n_i + n_j}}} \tag{1}$$

As suggested by Equation 1, the standard deviation of the difference (henceforth referred to as the pooled standard deviation) was computed in a two-step process. First, the sums of squared deviations for both groups were added, and the corresponding sum was divided by the total number of examinees in both groups. Second, the pooled standard deviation was obtained by taking the square root of the pooled variance. This method of computing the pooled standard deviation was appropriate because it described difference scores of random variables that were roughly normally distributed and were independent of one another. It was also appropriate because effect sizes in this study often described paired groups with different numbers of examinees. For the purposes of this study, effect sizes (ES) were interpreted consistent with other unpublished studies conducted by ACT staff. One might interpret effect sizes in the following manner: ES $<$ .25 indicates no effect (or difference), .25 $\leq$ ES $<$ .50 indicates a moderate effect, and .50 $\leq$ ES indicates a substantial effect.

Procedures

This study dealt with *public* school student records grouped by graduation year. For instance, data said to be "1995" data corresponded with the latest test scores for all test takers who graduated in 1995. Data across years used the same year classification scheme as the previous example. Mean Mathematics and Science Reasoning scores were used as measures of student achievement.

The population of ACT tested public school graduates was split according to whether or not students took a core curriculum in high school. Students said to have taken a core curriculum

"...took at least four years of English and at least three years each of mathematics, social studies, and natural sciences" (ACT, 1997; p. 39). Students were identified as core or non-core takers based on whether they took the entire college preparatory core, rather than focusing on the mathematics and science components of core.

Students were also classified into groups labeled as *intended mathematics – or science-related* or *intended non-mathematics- or science-related majors.* An intended mathematics- or science-related major was a student who indicated that he/she was "Fairly Sure" or "Very Sure" that he/she would major in a mathematics- or science-related field in college. The two groups were aggregated so as to define mathematics/science majors as those with a greater than nominal degree of certainty of majoring in a mathematics- or science-related field.

In an effort to promote comparability between the majors and non-majors, an intended non-mathematics- or science-related major was defined as a student who indicated an interest in majoring in a non-mathematics/science-related field, and was "Fairly Sure" or "Very Sure" of that choice. Choice of major by a pre-college student was not a concrete indicator of the final major earned at completion of college, but an indicator of a student's intent. This classification process allows one to draw conclusions about students with intent to major in a mathematics-/science-related field or some other field.

Results

Global Achievement

As addressed above, student achievement was assessed through the use of the ACT Assessment Mathematics and Science Reasoning tests. Results in Table 3 suggest that there has been little change in math or science achievement between the years 1995 and 2000.

TABLE 3

Mean ACT Mathematics and Science Reasoning Scores

		Graduation Year					
		1995	1996	1997	1998	1999	2000
ACT Mathematics	Mean	20.1	20.2	20.6	20.7	20.6	20.7
	SD	4.8	4.8	5.0	5.1	4.9	5.0
ACT Science Reasoning	Mean	21.0	21.1	21.1	21.1	21.0	21.0
	SD	4.5	4.6	4.6	4.6	4.5	4.5
N		767,987	770,078	788,745	811,783	831,276	864,201

ACT Mathematics scores went up between 1995 and 1997, with a change of .5 scale score points. This difference is negligible when one considers that it translates into an effect size of 0.12. The largest single-year change occurred between 1996 and 1997, but was a negligible 0.08 pooled standard deviations. The upward motion of mathematics score means leveled off after 1997, oscillating between 20.6 and 20.7 scale score points.

ACT Science Reasoning scores were even more stable. Between 1995 and 2000, the greatest change in mean scores never exceeded 0.1 ACT scale score points (ES=.02). In fact, when rounding to one decimal place, there was no difference between means for graduation years 1995 and 2000.

The stability in overall scores can be seen graphically in Figure 1:

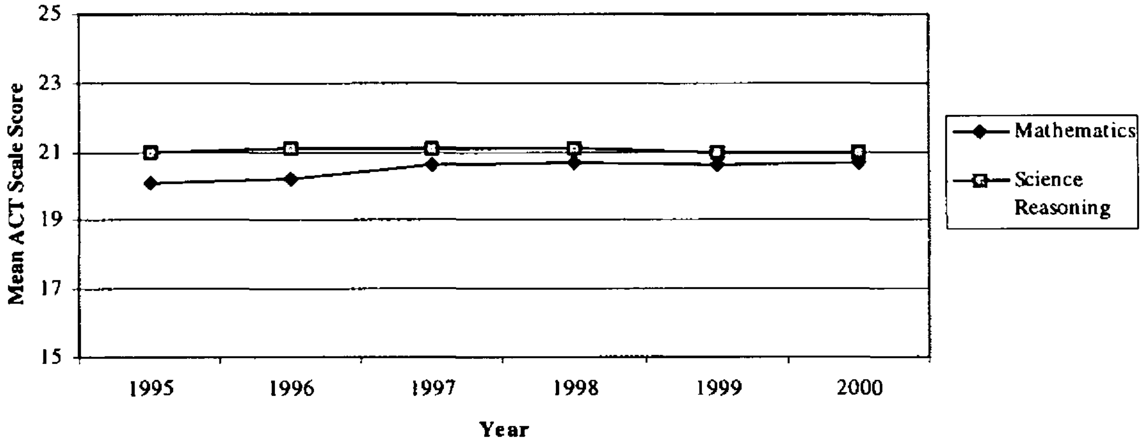

FIGURE 1. Global Mean ACT Mathematics and Science Reasoning Scores

Mean scores for within-group profiles of ACT Mathematics and Science Reasoning were relatively flat in this study, regardless of which subgroup was used. For this reason, the present study's between-group comparisons will focus only on intended mathematics- or science-related majors vs. intended non-mathematics- or science-related majors, and core takers vs. non-core takers.

Intended Mathematics/Science vs. Intended Non-Mathematics/Science Major Achievement

As can be seen by the results in Table 4, students who expressed an intent to major in a mathematics- or science-related field outperformed their non-mathematics/science counterparts on the ACT Mathematics test by a relatively uniform margin across time (ranging from 2.8 to 3.0 scale score points). This difference was substantial, as effect sizes ranged from 0.57 to 0.64.

TABLE 4

Mean ACT Scores of Students "Fairly Sure" or "Very Sure" of Intended Major

Major		1995	1996	1997	1998	1999	2000
				Graduation Year			
				Mathematics			
Mathematics/ Science-related	Mean	22.5	22.4	22.7	22.9	22.7	22.7
	SD	5.3	5.3	5.5	5.6	5.5	5.5
	N	(111,101)	(111,562)	(117,190)	(122,179)	(127,995)	(133,035)
Non-Mathematics/ Science-related	Mean	19.5	19.6	19.9	20.1	19.9	19.9
	SD	4.5	4.5	4.6	4.7	4.6	4.6
	N	(505,952)	(504,912)	(517,773)	(525,810)	(529,140)	(546,056)
Mean Difference Between Majors	Mean	3.0	2.8	2.8	2.8	2.8	2.8
				Science Reasoning			
Mathematics/ Science-related	Mean	22.7	22.8	22.8	22.7	22.4	22.4
	SD	5.0	5.0	5.1	5.1	4.9	5.0
	N	(111,101)	(111,562)	(117,190)	(122,179)	(127,995)	(133,035)
Non-Mathematics/ Science-related	Mean	20.5	20.6	20.6	20.6	20.5	20.5
	SD	4.3	4.3	4.4	4.4	4.3	4.3
	N	(505,952)	(504,912)	(517,773)	(525,810)	(529,140)	(546,056)
Mean Difference Between Majors	Mean	2.2	2.2	2.2	2.1	1.9	1.9

Though some minor change was observed in the achievement levels of both groups in Table 4, Figure 2 illustrates that these changes are but pieces of generally flat profiles. In essence, intended mathematics- or science-related majors and intended non-mathematics- or science-related majors did not exhibit meaningful increases in mathematics scores between 1995 and 2000, with changes of 0.2 points (ES=0.04) and 0.4 points (ES=0.09), respectively.

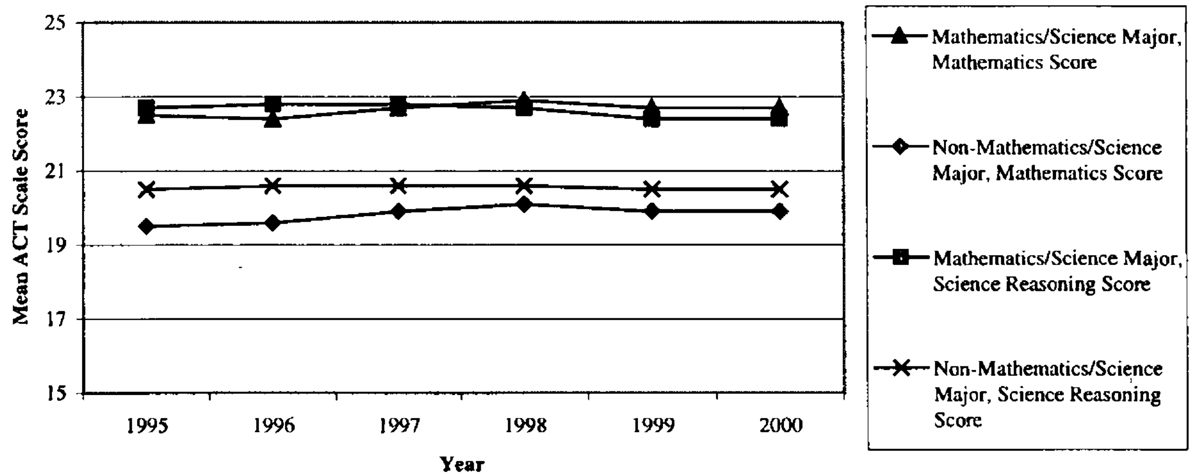

FIGURE 2. Mean ACT Scores, Comparing Students "Fairly Sure" or "Very Sure"of Intended

As with mathematics, mean scores on the Science Reasoning test showed a small amount of variability from one year to the next (see Table 4). The difference between intended mathematics- or science-related majors and intended non-mathematics- or science-related majors was relatively uniform and practically significant over time. Intended mathematics- or science-related majors performed moderately to substantially higher than their non-major counterparts by between 1.9 points (ES=0.43) and 2.2 points (ES=0.50).

The profiles of scores illustrate a small amount of variation in means from one year to the next. There was a decline of 0.3 points in Science Reasoning between the years 1998 and 1999 for intended mathematics- or science-related majors, but the decline was insignificant in a practical sense (ES=0.06; see Figure 2). For both mathematics and science, the difference in mean performance for intended mathematics/science majors and intended non-mathematics/science majors decreased slightly over time. Furthermore, standard deviations remained fairly constant for both groups in Mathematics and Science Reasoning.

Core vs. Non-Core Completor Achievement

One result can be seen when comparing achievement levels between groups of students taking core and non-core sequences. Specifically, average ACT Mathematics and Science Reasoning scores for students taking core sequences surpassed their non-core counterparts by a substantial margin. The mathematics results presented in Table 5 highlight this point with core/non-core differences of between 2.9 (ES=0.60) and 3.3 (ES=0.73) ACT score scale points.

TABLE 5

Mean ACT Scores by Curriculum

		Mathematics Scores Graduation Year					
Curriculum Taken		1995	1996	1997	1998	1999	2000
Core	Mean	21.5	21.5	21.8	21.9	21.8	21.7
	SD	4.7	4.7	4.9	5.0	4.9	5.0
	N	(449,791)	(459,804)	(475,107)	(505,789)	(512,841)	(537,462)
Non-Core	Mean	18.2	18.4	18.7	18.8	18.8	18.8
	SD	4.3	4.2	4.4	4.5	4.4	4.5
	N	(312,517)	(305,521)	(308,644)	(300,615)	(312,564)	(319,073)
Missing Indicator[1]	Mean	19.3	18.9	19.1	19.2	19.5	19.9
	SD	4.7	4.6	4.8	4.9	4.9	4.8
	N	(5,679)	(4,753)	(4,994)	(5,379)	(5,871)	(7,666)
Mean Difference Between Core and Non-Core	Mean	3.3	3.1	3.1	3.1	3.0	2.9

		Science Reasoning Scores Graduation Year					
Curriculum Taken		1995	1996	1997	1998	1999	2000
Core	Mean	22.0	22.0	22.1	22.0	21.9	21.8
	SD	4.5	4.5	4.6	4.5	4.4	4.5
	N	(449,791)	(459,804)	(475,107)	(505,789)	(512,841)	(537,462)
Non-Core	Mean	19.5	19.6	19.6	19.6	19.5	19.7
	SD	4.2	4.2	4.3	4.3	4.3	4.3
	N	(312,517)	(305,521)	(308,644)	(300,615)	(312,564)	(319,073)
Missing Indicator[1]	Mean	20.3	20.0	19.9	19.9	20.0	20.3
	SD	4.9	5.0	4.9	4.9	4.8	4.6
	N	(5,679)	(4,753)	(4,994)	(5,379)	(5,871)	(7,666)
Mean Difference Between Core and Non-Core	Mean	2.5	2.4	2.5	2.4	2.4	2.1

[1]Indicates students who provided insufficient information to be classified as core or non-core

Though differences between core and non-core taker Science Reasoning test scores presented in Table 5 were smaller than for scores on the Mathematics test, a similar pattern emerged. Namely, core takers surpassed non-core takers by a moderate to substantial margin, ranging from 2.1 (ES=0.48) to 2.5 (ES=0.57) scale score points per year.

Consideration of patterns in student achievement over time demonstrated negligible change. Groups of students taking core demonstrated a 1995-2000 increase in mathematics of 0.2 (ES=0.04) points and a decrease in Science Reasoning of 0.2 (ES=-0.04) points. Groups of students not taking core demonstrated a negligible 0.6 (ES=0.14) point increase in mathematics and 0.2 (ES=0.05) point increase in Science Reasoning between the years 1995 and 2000. The difference between core and non-core means within Mathematics and Science Reasoning scores diminished slightly over time. Mathematics and Science Reasoning scores also exhibited fairly stable standard deviations except for a slight increase in core/Mathematics standard deviations over time. The patterns in means can be seen in Figure 3.

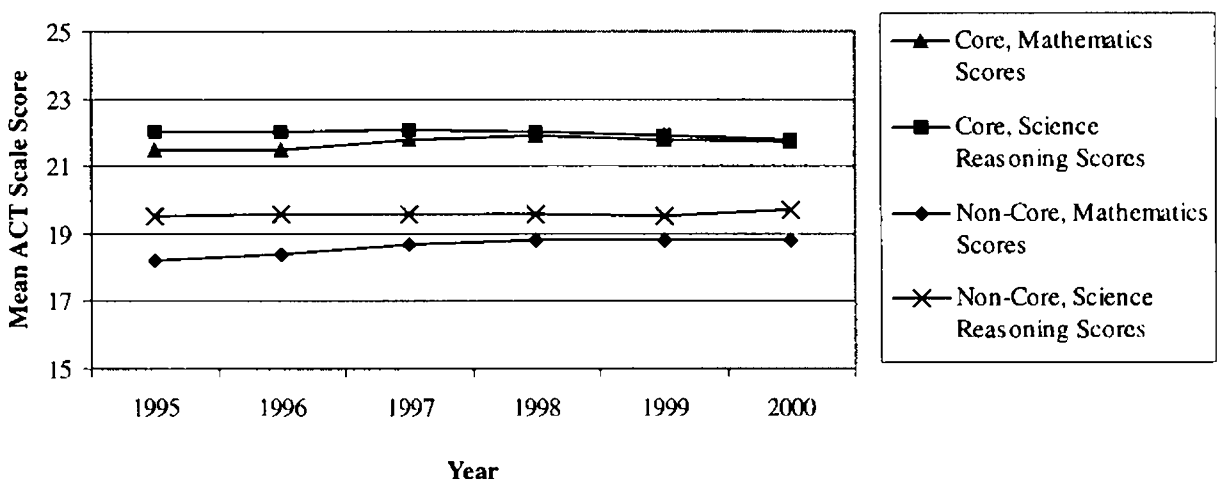

FIGURE 3. Mean ACT Scores, Comparing Core-Takers to Non-Core-Takers

Trends in Percentages of Students Taking Core

After reviewing trends in student achievement, another area of interest dealt with curricular antecedents to taking tests of achievement. As one can see in Table 6, the percentage of students taking a core curriculum increased by 3.7% from 1995 to 2000. However, the increase became inconsistent during the years 1998 through 2000.

TABLE 6

Curriculum Choices

		Graduation Year					
Curriculum Taken		1995	1996	1997	1998	1999	2000
Core Curriculum	N	449,791	459,804	475,107	505,789	512,841	537,462
	Percent [1]	59.0	60.1	60.6	62.7	62.1	62.7
Non-Core Curriculum	N	312,517	305,521	308,644	300,615	312,564	319,073
	Percent [1]	41.0	39.9	39.4	37.3	37.9	37.3
Missing Indicator	N	5,679	4,753	4,994	5,379	5,871	7,666

[1]Totals for calculation of percents do not include records with a missing curriculum indicator

The numbers in Table 6 don't convey the full flavor of changes in percentages of students taking a core curriculum. Figure 4 helps in this regard. One should notice the increase in core taking in 1998, followed by no upward movement.

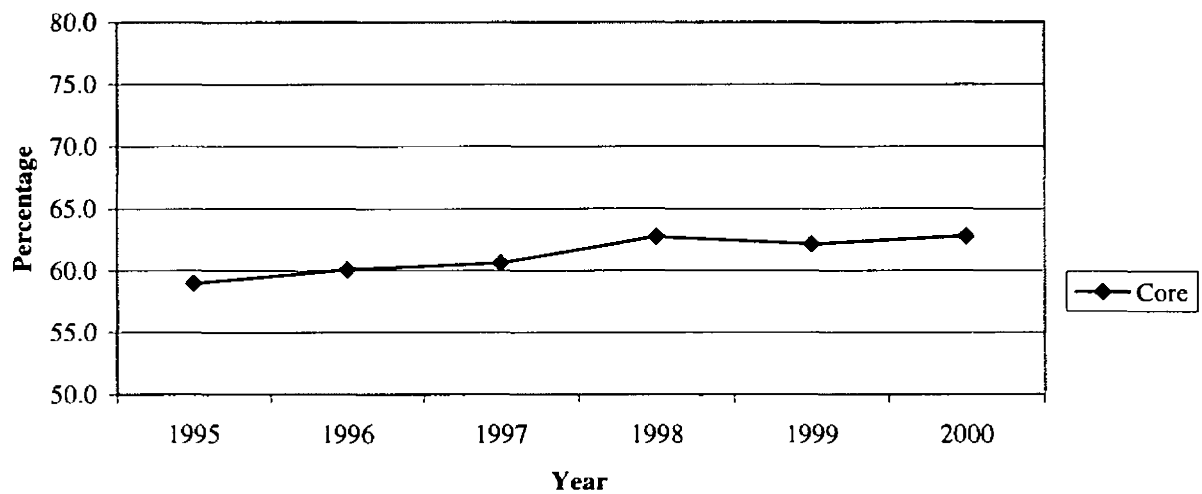

FIGURE 4. Percentages of Students Taking Core Curricula

Trends in Percentages of Majors

The final result under consideration in this study is the percentage of students indicating that they are "Fairly" or "Very" sure of their intent to major in a mathematics- or science-related field. Table 7 presents these results.

TABLE 7

N Counts and Percentages of Students With Differential College Major Intents

	Graduation Year					
	1995	1996	1997	1998	1999	2000
	Mathematics/Science-Related Majors					
Percent M/S majors, relative to examinees who were "Fairly" or "Very" sure of intended major	18.0%	18.1%	18.5%	18.9%	19.5%	19.6%
Percent relative to total sample	14.5%	14.5%	14.9%	15.1%	15.4%	15.4%
N	111,101	111,562	117,190	122,179	127,995	133,035
	Non-Mathematics/Science-Related Majors					
Percent non-M/S majors, relative to examinees who were "Fairly" or "Very" sure of intended major	82.0%	81.9%	81.5%	81.1%	80.5%	80.4%
Percent relative to total sample	65.9%	65.6%	65.6%	64.8%	63.7%	63.2%
N	505,952	504,912	517,773	525,810	529,140	546,056
	"Not Sure" or Not Specified Majors					
Percent not indicating an intended major, or "Not Sure" of intended major, relative to total sample	19.7%	19.9%	19.5%	20.2%	20.9%	21.4%
N	150,934	153,604	153,782	163,794	174,141	185,110
	Totals					
Percent "Fairly" or "Very" sure of intended major relative to total sample	80.3%	80.1%	80.5%	79.8%	79.1%	78.6%
N: "Fairly" or "Very" sure of intended major[1]	617,053	616,474	634,963	647,989	657,135	679,091
N: Total	767,987	770,078	788,745	811,783	831,276	864,201

[1] N's do not include "Not Sure" and "Missing"

The percentages in Table 7 are plotted in Figure 5, and suggest a slight increasing trend in the percentage of students who intend to major in a mathematics- or science-related field. This pattern holds regardless of whether one compares the frequency of students who are

"Fairly" or "Very" sure of majoring in a mathematics- or science-related field to all students with equivalent degrees of sureness or to all students. This increase has been fairly steady but slight, with an overall 0.9% change relative to the population as a whole, and 1.6% change relative to all students "Fairly" or "Very" sure of their intended major.

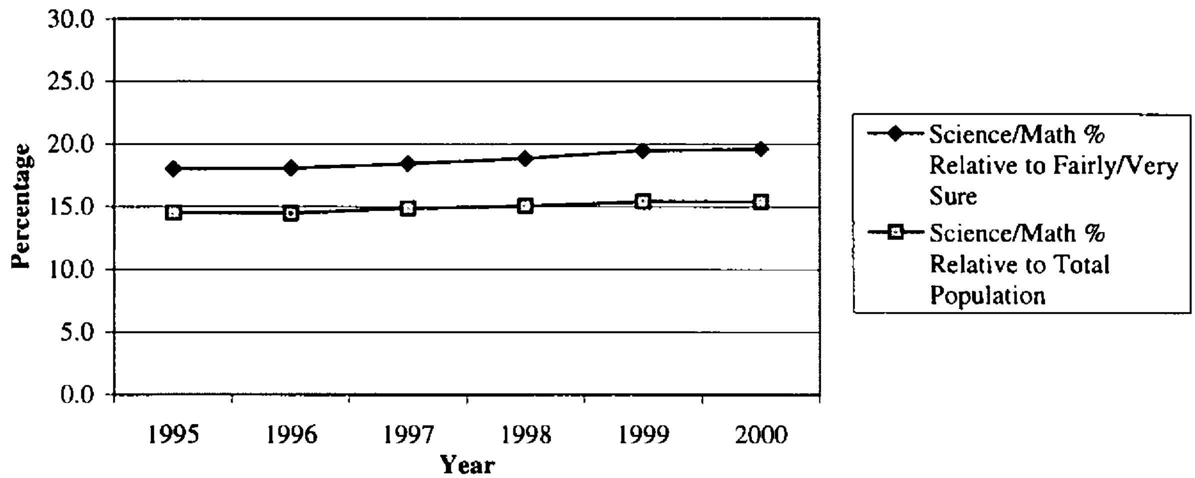

FIGURE 5. Percentages of Students With Intent to Major in Mathematics-/Science-Related Field

Conclusions and Discussion

Goal 5: "By the Year 2000, United States students will be first in the world in mathematics and science achievement" (H.R. 1804, Sect. 102.5.A, 1994)

Discussion of Overall Results. Findings regarding the general statement of Goal 5 are not encouraging. ACT Mathematics and Science Reasoning scores exhibited negligible change for 1995 through 2000 graduates. This finding parallels NAEP Long Term Assessment mathematics and science results described earlier, which indicated a decreasing rate of improvement in mathematics and a plateau in science since the early-to-mid 1990's.

Combining the findings of this study with those from the NAEP Long Term Assessment presents a consistent conclusion: *Achievement for many U.S. high-school aged students in mathematics and science has not changed appreciably since the mid-1990's relative to a* *domestic criterion.* Domestic patterns, taken in conjunction with lackluster international performance of U.S. students on TIMSS, suggests that attainment of Goal 5 has not occurred unless the rest of the world has experienced a serious decrease in student achievement in mathematics and science in recent years. This international decline appears highly unlikely.

Discussion of Goal 5 Results by Intended Major. Performance trends were equally flat when students were compared on the basis of intended major. The corresponding stable standard deviations observed across years when analyzing on the basis of intended major suggest further that notable changes are not occurring in the tails of the ACT Mathematics and Science Reasoning score distributions, either. However, the degree to which intended mathematics- or science-related majors outperformed intended non-mathematics- or science-related majors decreased slightly between 1995 and 2000. Two possible interpretations of this finding are:

1. Factors that once gave rise to differences between intended mathematics- or science-related and non-mathematics- or science-related majors are gradually diminishing in their potency; and

2. Educational objectives present in courses more commonly taken by intended mathematics- or science-related majors are increasingly being infused into more general coursework taken by or everyday lives of intended non-mathematics- or science-related majors.

Either, none, or both of these explanations may apply to the present educational situation, but further exploration into their accuracy is beyond the scope of this paper.

Discussion of Goal 5 Results by Curriculum. When looking at student achievement in ACT Mathematics and Science Reasoning as a function of whether or not students took a core curriculum, core takers outperformed non-core takers. However, the gap between the two groups decreased slightly with time. To better understand this decreasing gap, post-hoc comparisons of standard deviations were also conducted. A picture begins to emerge when this decrease is taken in concert with an increase in standard deviations (especially in mathematics), increasing numbers of students taking the ACT Assessment, and a slight increase in percent of core takers. Namely, these conditions describe increased numbers of high- and low-proficiency students. Changes in the tails of the distributions are balancing each other out, however, as indicated by the lack of meaningful change in mean achievement. Though no causal analyses have been conducted, a possible explanation for this increase in the extremes of the score distributions could rest in greater collegiate accessibility to lower proficiency students, and increased educational opportunities for advanced growth of high proficiency students (e.g., TAG programs, AP courses, etc.).

When considering the decreasing gap between core and non-core takers, possible interpretations of this change may involve implementation of educational objectives. Though a higher percentage of students were observed taking core, the lack of change in performance might be due to an increase in the proportion of low proficiency students taking core who would formerly have avoided doing so, thereby drawing the group mean down. The decreasing gap may also be the result of an issue parallel to that expressed regarding intended mathematics- or science-related majors and non-majors: the infusion of formerly core-specific content into non-core courses. This could have the effect of increasing the similarity of learning objectives between core and non-core courses. Further investigation of these interpretations is beyond the scope of this document.

Goal 5, Objective 1: Mathematics and Science Education Will Be Strengthened Throughout the Educational System

Objective 1 was investigated in a limited sense. In particular, the present study interpreted changes in the percent of core takers as a reflection of the strength of education in general, and mathematics and science education in particular. The consistent, though slight, increase in percentage of core takers between 1995 and 2000 (inclusive) is promising, as taking core curricula has been described as the "...foundation of success for the after-school years..." (NCEE, 1983; p. 24). The U.S. educational system has room for improvement in student curricular choice, however, since between 37% and 41% of students in a given year who take the ACT Assessment do not take a core curriculum. Furthermore, nearly 30% of all year 2000 graduates who took the ACT Assessment and intend to major in a mathematics- or science-related field *do not take core* (Harmston & Pliska, in press).

Goal 5, Objective 3: The number of U.S. graduate and undergraduate students completing degrees in mathematics, science, or engineering will increase

As indicated earlier, this study could not directly address Objective 3. However, this objective was indirectly investigated by observing trends in the percent of students who indicated being "Fairly Sure" or "Very Sure" of their intent to major in a mathematics- or science-related field when taking the ACT Assessment. Though these students may or may not eventually end up majoring in a mathematics- or science-related field, this study found that there was a slight increasing trend in the percentage of students who intended to pursue such majors. This provides indirect evidence of progress toward Objective 3.

Summary

Since 1995, student achievement on ACT Mathematics and Science Reasoning tests has shown little consistent change. However, there has been a slight increase in the percentage of students taking a core curriculum, and in the percentage of students intending to major in a mathematics- or science-related field. As has been shown, core takers outperform non-core takers on average, as do intended mathematics- or science-related majors relative to non-majors. Yet, the achievement gap between groups defined on the basis of core/non-core or intended major has slightly decreased. Thus, achievement levels do not appear to have changed much. However, the increase in core takers suggests some strengthening in education.

From a less optimistic perspective, at least 37% of all public school graduates between the years 1995 and 2000 (inclusive) who took the ACT Assessment did not take a core curriculum. Given the relationship of taking core to higher achievement levels, high school faculty and staff would be putting their students (college bound or otherwise) at a disadvantage were they not to promote taking a core curriculum.

It would be safe to say that Goal 5 of Goals 2000 was not met by the year 2000. But, domestically, at least a small degree of progress has been observed. In light of current relatively flat achievement profiles, increased percentages of core takers and intended mathematics- or science-related majors raises some hope for the present plateau in student achievement to give way to increases in mathematics and science achievement.

Questions for Future Study

1. Will present flat profiles in mathematics and science resume the upward trend observed throughout the 1980's and early 1990's?

2. Are educational objectives that were once most prevalent in core coursework being increasingly infused into the non-core classroom?

3. How much stability is there between intended major as indicated on the ACT Assessment and actual college major attained?

Limitations

1. Because there is no guarantee that students taking the ACT Assessment will actually attend college, this study does not permit hard and fast conclusions regarding *college bound* students.

2. Though data for each year used in this study consisted of all public school graduates who had valid ACT Assessment records, the groups within given years are not representative of the nation as a whole. Therefore, any generalization beyond past, present, and future ACT Assessment examinees must be done with caution.

3. A core curriculum was defined in terms of all content areas identified earlier, rather than just mathematics and science. This limits our ability to compare students on the basis of whether or not they took a *mathematics/science* core. However, it does permit comparison of students who did or did not take a *complete* core.

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