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HIGHER EDUCATION

Science, Technology, Engineering, and Mathematics Trends and the Role of Federal Programs

Statement of Cornelia M. Ashby, Director,
Education, Workforce, and Income Security Issues





Highlights of [GAO-06-702T](#), a report to Committee on Education and the Workforce, House of Representatives

Why GAO Did This Study

The United States is a world leader in scientific and technological innovation. To help maintain this advantage, the federal government has spent billions of dollars on education programs in the science, technology, engineering, and mathematics (STEM) fields for many years. However, concerns have been raised about the nation's ability to maintain its global technological competitive advantage in the future.

This testimony is based on our October 2005 report and presents information on (1) trends in degree attainment in STEM- and non-STEM-related fields and factors that may influence these trends, (2) trends in the levels of employment in STEM- and non-STEM-related fields and factors that may influence these trends, and (3) federal education programs intended to support the study of and employment in STEM-related fields. For this report, we analyzed survey responses from 13 civilian federal departments and agencies; analyzed data from the Departments of Education and Labor; interviewed educators, federal agency officials, and representatives from education associations and organizations; and interviewed students.

www.gao.gov/cgi-bin/getrpt?GAO-06-702T.

To view the full product, including the scope and methodology, click on the link above. For more information, contact Cornelia M. Ashby at (202) 512-7215 or AshbyC@gao.gov.

HIGHER EDUCATION

Science, Technology, Engineering, and Mathematics Trends and the Role of Federal Programs

What GAO Found

While postsecondary enrollment has increased over the past decade, the proportion of students obtaining degrees in STEM fields has fallen. In academic year 1994–1995, about 519,000 students (32 percent) obtained STEM degrees. About 578,000 students obtained STEM degrees in academic year 2003–2004, accounting for 27 percent of degrees awarded. Despite increases in enrollment and degree attainment by women and minorities at the graduate level, the number of graduate degrees conferred fell in several STEM-related fields from academic year 1994–1995 to academic year 2003–2004. College and university officials and students most often cited subpar teacher quality and poor high school preparation as factors that discouraged the pursuit of STEM degrees. Suggestions to encourage more enrollment in STEM fields include increased outreach and mentoring.

The past decade has seen an increase in STEM employees, particularly in mathematics and computer science. From 1994 to 2003, employment in STEM fields increased by an estimated 23 percent, compared to 17 percent in non-STEM fields. Mathematics and computer science showed the highest increase in STEM-related employment, and employment in science-related fields increased as well. However, in certain STEM fields, including engineering, the number of employees did not increase significantly. Further, while the estimated number of women, African-Americans, and Hispanic-Americans employed in STEM fields increased, women and minorities remained underrepresented relative to their numbers in the civilian labor force. The number of foreign workers employed in the United States has fluctuated, experiencing declines in 2002 and 2003. Key factors affecting STEM employment decisions include mentoring for women and minorities and opportunities abroad for foreign employees.

Thirteen federal civilian agencies spent approximately \$2.8 billion in fiscal year 2004 to fund over 200 programs designed to increase the numbers of students in STEM fields and employees in STEM occupations and to improve related educational programs. The funding reported for individual STEM education programs varied significantly, and programs most commonly provided financial support to students or infrastructure support to institutions. However, only half of these programs had been evaluated or had evaluations underway, and coordination among STEM education programs was limited. It is important to know the extent to which existing STEM education programs target the right people and the right areas and make the best use of available resources. Since our report was issued in October 2005, Congress, in addition to establishing new grants to encourage students from low-income families to enroll in STEM fields, established an Academic Competitiveness Council to identify, evaluate, coordinate, and improve federal STEM programs.

Mr. Chairman and Members of the Committee:

Thank you for inviting me here today to discuss U.S. trends in the fields of science, technology, engineering, and mathematics (STEM) in relation to the changing domestic and global economies. The health of the U.S. economy is directly tied to our science and technology industries, and the United States is a world leader in scientific and technological innovation. Since 1995, for example, the United States has generated the largest share of high-technology manufacturing output of any country in the world. Concerns have been raised, however, about the nation's ability to maintain its technological competitive advantage, especially in light of other nations' investments in their own research infrastructures, the aging and changing U.S. workforce, and the fiscal challenges facing the nation. From 1990 to 2003, research and development expenditures outside the United States have more than doubled, from about \$225 billion to over \$500 billion. According to the Census Bureau, the median age of the U.S. population in 2004 was the highest it had ever been, and the growth of the labor force is expected to slow considerably, becoming negligible by 2050. Further, as the United States becomes a more diverse society, minorities, in addition to women, will continue to represent a continuously increasing share of the workforce, yet women and minorities have tended to be underrepresented in STEM education programs and career fields. These factors, concurrent with the nation's large and growing long-term fiscal imbalance, present significant and difficult challenges for policymakers as they tackle how best to ensure that our nation can continue to compete in the global marketplace.

My testimony today will focus on three key issues: (1) trends in degree attainment in STEM- and non-STEM-related fields and factors that may influence these trends, (2) trends in the levels of employment in STEM- and non-STEM-related fields and factors that may influence these trends, and (3) federal education programs intended to support the study of and employment in STEM-related fields. My comments are based on the findings from our October 2005 report, *Higher Education: Federal Science, Technology, Engineering, and Mathematics Programs and Related Trends*.¹ Those findings were based on our review and analysis of data from a variety of sources. For that report we (1) analyzed survey responses from 13 federal departments and agencies with STEM education

¹ GAO, *Higher Education: Federal Science, Technology, Engineering, and Mathematics Programs and Related Trends*, GAO-06-114 (Washington, D.C.: Oct. 12, 2005).

programs;² (2) analyzed data on students and graduates from the Department of Education's (Education) National Center for Education Statistics (NCES) and on employees from the Department of Labor's (Labor) Bureau of Labor Statistics (BLS); (3) interviewed educators and administrators at eight colleges and universities, federal agency officials, and representatives from associations and education organizations; (4) conducted interviews via e-mail with 31 students from five universities we visited; and (5) reviewed reports on various topics related to STEM education and occupations.³ For this testimony, we provide updated information concerning the number of graduates in STEM and non-STEM fields as well as congressional legislation related to STEM education programs. Our work was conducted in accordance with generally accepted government auditing standards.

In summary, our findings are as follows:

- While postsecondary enrollment has increased over the past decade, the proportion of students obtaining degrees in STEM fields has fallen. In academic year 1994–1995, about 519,000 students obtained STEM degrees, about 32 percent of all degrees awarded. More students—approximately 578,000—obtained STEM degrees in academic year 2003–2004, but such degrees accounted for only 27 percent of those awarded. While the number of degrees obtained in some STEM fields increased, the number of degrees obtained in engineering, biological science, and certain technical fields declined. Further, despite increases in the overall enrollment and degree attainment by women and minorities at the graduate level, the number of graduate degrees conferred fell in several STEM-related fields from academic year 1994–1995 to academic year 2003–2004. College and university officials and students cited subpar teacher quality at the high school and college levels, poor high school preparation, more rigorous and expensive degree requirements for STEM majors, and lower pay of STEM occupations relative to such fields as law and business as factors that discouraged students from pursuing degrees in STEM fields. Suggestions to encourage more enrollment in STEM fields include increased outreach

² The Department of Defense (DoD) did not submit a survey. According to DoD officials, DoD needed 3 months to complete the survey and therefore could not provide responses within the time frames of our work.

³ For the purposes of this testimony, we will use the term “agency” when referring to any of the 13 federal departments and agencies that responded to our survey.

at the kindergarten through 12th grade level, increased mentoring, and a greater federal presence.

- Coinciding with the spread of the Internet and the personal computer, the past decade has seen an increase in the overall number of STEM employees, particularly in mathematics and computer science. From 1994 to 2003, overall employment in STEM fields increased by an estimated 23 percent, compared to an estimated 17 percent increase in non-STEM fields. Mathematics and computer science showed the highest increase in STEM-related employment—estimated at 78 percent—while employment in science-related fields increased an estimated 20 percent. However, in certain STEM fields, including engineering, the number of employees did not increase significantly over the 1994–2003 period. Further, while the estimated number of women employed in STEM fields increased, there was not a significant change in the percentage they comprised. While the number of African-Americans and Hispanic-Americans employed in STEM fields increased from 1994 to 2003, minorities remained underrepresented relative to their numbers in the civilian labor force. Although foreign workers have filled more than 100,000 positions annually, many in STEM fields, through the H–1B visa program, employment levels declined in 2002 and 2003 after several years of increases.⁴ Key factors affecting STEM employment decisions include mentoring for women and minorities and opportunities abroad for foreign employees.

- The federal government spent approximately \$2.8 billion in fiscal year 2004 to fund over 200 programs designed to increase the numbers of students in STEM fields and employees in STEM occupations and to improve related educational programs. Thirteen federal civilian agencies operated these programs, and most programs provided either financial support to individuals, particularly to students and scholars, or equipment, building, and other infrastructure support to institutions. The funding reported for individual STEM education programs varied significantly, from \$4,000 for a U.S. Department of Agriculture-sponsored program to \$547 million for a National Institutes of Health (NIH) grant program. However, only half of these programs had been evaluated or had evaluations underway, and coordination among STEM education programs was limited. As we note in our 2005 report, it is important to know the extent to which existing STEM education programs target the right people

⁴ H–1B visas allow noncitizens to work in the United States.

and the right areas and make the best use of available resources before expanding federal support.

Since our report was issued in October 2005, several initiatives to improve federal support have taken place. For example, Congress established National Science and Mathematics Access to Retain Talent (SMART) Grants to encourage students from low-income families to enroll in STEM fields and foreign languages critical to the national security of the United States. In addition, Congress established an Academic Competitiveness Council, chaired by the Secretary of Education, to identify, evaluate, coordinate, and improve federal STEM programs. Further, according to Education, the department plans to determine which federal programs work best for students and how to use taxpayers' dollars more efficiently, as well as how to align programs with the accountability principles of the No Child Left Behind Act of 2001 (NCLBA).⁵

Background

STEM fields include a wide range of disciplines and occupations, including agriculture, physics, psychology, medical technology, and automotive engineering. Many of these fields require completion of advanced courses in mathematics or science, subjects that are first introduced and developed at the kindergarten through 12th grade level. The federal government, universities and colleges, and other entities have taken steps to help improve achievement in these and other subjects through such actions as enforcement of NCLBA, which addresses both student and teacher performance at the elementary and secondary school levels, and implementation of programs to increase the numbers of women, minorities, and students with disadvantaged backgrounds in the STEM fields at postsecondary school levels and later in employment.

The participation of domestic students in STEM fields—and in higher education more generally—is affected both by the economy and by demographic changes in the U.S. population. Enrollment in higher education has declined with upturns in the economy because of the increased opportunity costs of going to school when relatively high wages are available. The choice between academic programs is also affected by the wages expected to be earned after obtaining a degree. Demographic

⁵ Pub. L. No. 107-110 (2002). NCLBA amended and reauthorized the Elementary and Secondary Education Act—the largest and most comprehensive federal education law—and focused on improving students' academic performance.

trends affect STEM fields because different races and ethnicities have had different enrollment rates, and their representation in the population is changing. In particular, STEM fields have had a relatively high proportion of white or Asian males, but the proportion of other minorities enrolled in the nation's public schools, particularly Hispanics, has almost doubled since 1972. Furthermore, as of 2002, American Indians, Asians, African-Americans, Hispanics, and Pacific Islanders constituted 29 percent of all college students.

Students and employees from foreign countries have pursued STEM degrees and worked in STEM occupations in the United States as well. To do so, these students and employees must obtain education or employment visas.⁶ Visas may not be issued to students for a number of reasons, including concerns that the visa applicant may engage in the illegal transfer of sensitive technology. Many foreign workers enter the United States annually through the H-1B visa program, which assists U.S. employers in temporarily filling specialty occupations. Employed workers may stay in the United States on an H-1B visa for up to 6 years, and the current cap on the number of H-1B visas that can be granted is 65,000. The law exempts certain workers from this cap, including those in specified positions or holding a master's degree or higher from a U.S. institution.

The federal government also plays a role in helping coordinate federal science and technology initiatives. The National Science and Technology Council (NSTC) was established in 1993 and is the principal means for the Administration to coordinate science and technology policies. One objective of NSTC is to establish clear national goals for federal science and technology investments in areas ranging from information technologies and health research to improving transportation systems and strengthening fundamental research.

⁶ There are several types of visas that authorize people to study and work in the United States. F visas (student visas) are for study at 2- and 4-year colleges and universities and other academic institutions; J visas (exchange visitor visas) are for people who will be participating in a cultural exchange program; L visas (intracompany transferee visas) are for managerial positions and for those with specialized skills; and M visas are for nonacademic study, such as at vocational and technical schools. In addition, H-1B visas allow noncitizens to work in the United States.

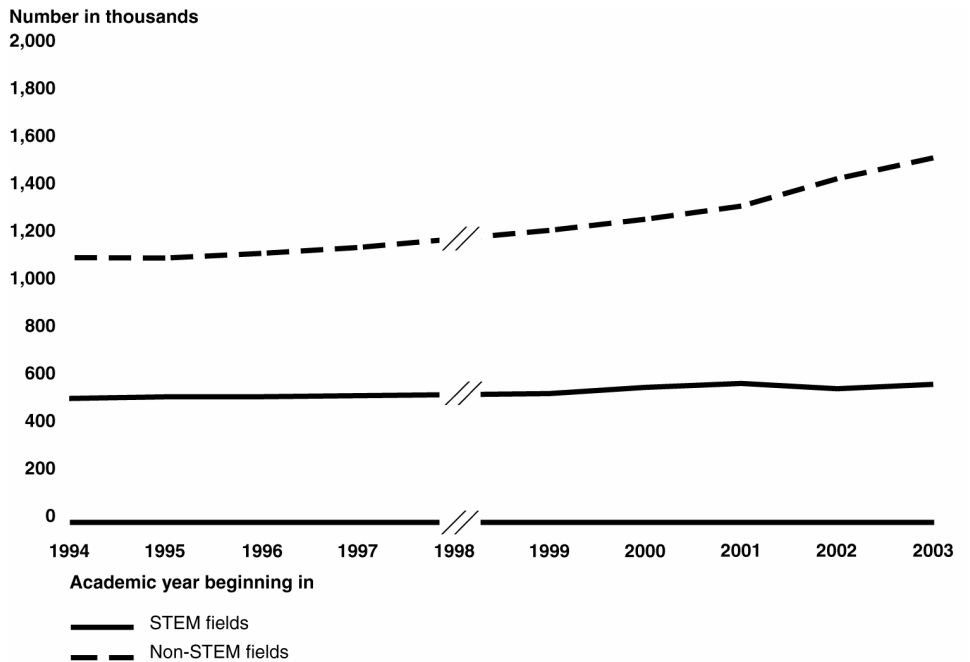
The Proportion of Students Obtaining Degrees in STEM Fields Has Fallen, and Teacher Quality and High School Preparation Were Cited as Influential Factors

From the 1994–1995 academic year to the 2003–2004 academic year, the number of graduates with STEM degrees increased, but the proportion of students obtaining degrees in STEM fields fell. Teacher quality, academic preparation, collegiate degree requirements, and the pay for employment in STEM fields were cited by university officials and Education as factors affecting the pursuit of degrees in these fields.

Total Number of Graduates with STEM Degrees Increased, but Numbers Decreased in Some Fields, and Proportions of Minority Graduates at the Master's and Doctoral Levels Did Not Change

The number of graduates with degrees in STEM fields increased from approximately 519,000 to approximately 578,000 from the 1994–1995 academic year to the 2003–2004 academic year. However, during this same period, the number of graduates with degrees in non-STEM fields increased from about 1.1 million to 1.5 million. Thus, the percentage of students with STEM degrees decreased from about 32 percent to about 27 percent of total graduates. The largest increases at the bachelor's and master's levels were in mathematics and the computer sciences, and the largest increase at the doctoral level was in psychology. However, the overall number of students earning degrees in engineering decreased in this period, and the number of students earning doctoral degrees in the physical sciences and bachelor's degrees in technology-related fields, as well as several other fields, also declined. Figure 1 shows the number of graduates for STEM and non-STEM fields in the 1994–1995 through 2003–2004 academic years.

Figure 1: Number of Graduates in STEM and Non-STEM Fields, 1994–1995 through 2003–2004 Academic Years



Source: GAO calculations based upon Integrated Postsecondary Education Data System (IPEDS) data.

Note: Information for academic year 1998–1999 was not reported by IPEDS.

From the 1994–1995 academic year to the 2002–2003 academic year, the proportion of women earning degrees in STEM fields increased at the bachelor’s, master’s, and doctoral levels, and the proportion of domestic minorities increased at the bachelor’s level. Conversely, the total number of men graduates decreased, and the proportion of men graduates declined in the majority of STEM fields at all educational levels in this same period. However, men continued to constitute over 50 percent of the graduates in most STEM fields. The proportion of domestic minorities increased at the bachelor’s level but did not change at the master’s or doctoral level. In the 1994–1995 and 2002–2003 academic years, international students earned about one-third or more of the degrees at both the master’s and doctoral levels in engineering, math and computer science, and the physical sciences.

Teacher Quality, Mathematics and Science Preparation, and Other Factors Were Cited as Key Influences on Domestic Students' STEM Participation Decisions

University officials told us and researchers reported that the quality of teachers in kindergarten through 12th grades and the levels of mathematics and science courses completed during high school affected students' success in and decisions about pursuing STEM fields. University officials said that some teachers were unqualified and unable to impart the subject matter, causing students to lose interest in mathematics and science. In 2002, Education reported that, in the 1999–2000 school year, 45 percent of the high school students enrolled in biology/life science classes and approximately 30 percent of those enrolled in mathematics, English, and social science classes were instructed by teachers without a major, minor, or certification in these subjects—commonly referred to as “out-of-field” teachers.⁷ Also, states reported that the problem of underprepared teachers was worse on average in districts that serve large proportions of high-poverty children.

In addition to teacher quality, students' high school preparation in mathematics and science was cited by university officials and researchers as a factor that influenced students' participation and success in the STEM fields. For example, university officials said that, because many students had not taken higher-level mathematics and science courses such as calculus and physics in high school, they were immediately behind other students. A study of several hundred students who had left the STEM fields reported that about 40 percent of those college students who left the science fields reported some problems related to high school science preparation.⁸

Several other factors were cited by university officials, students, and others as influencing decisions about participation in STEM fields. These factors included the relatively low pay in STEM occupations, additional tuition costs to obtain STEM degrees, and the availability of mentoring, especially for women and minorities, in the STEM fields. For example, officials from five universities told us that low pay in STEM occupations relative to other fields such as law and business dissuaded students from pursuing STEM degrees. Also, in a study that solicited the views of college

⁷ National Center for Education Statistics, *Qualifications of the Public School Teacher Workforce: Prevalence of Out-of-Field Teaching 1987–88 to 1999–2000*, May 2002, revised August 2004, Washington, D.C.

⁸ The student study results are from Seymour, Elaine, and Nancy M. Hewitt, *Talking about Leaving: Why Undergraduates Leave the Sciences*, Westview Press, 1997, Boulder, Colorado.

students who left the STEM fields as well as those who continued to pursue STEM degrees, researchers found that students experienced greater financial difficulties in obtaining their degrees because of the extra time needed to obtain degrees in certain STEM fields.⁹

University officials, students, and other organizations suggested a number of steps that could be taken to encourage more participation in the STEM fields. University officials and students suggested more outreach, especially to women and minorities from kindergarten through the 12th grade. One organization, Building Engineering and Science Talent (BEST), suggested that research universities increase their presence in pre-kindergarten through 12th grade mathematics and science education in order to strengthen domestic students' interests and abilities. In addition, the Council of Graduate Schools called for a renewed commitment to graduate education by the federal government through actions such as providing funds to support students trained at the doctoral level in the STEM fields and expanding participation in doctoral study in selected fields through graduate support awarded competitively to universities across the country. University officials suggested that the federal government could enhance its role in STEM education by providing more effective leadership through developing and implementing a national agenda for STEM education and increasing federal funding for academic research.

STEM Employment Rose in Math and Science, but There Is No Evidence of an Increase in Engineering or Technology

Although the total number of STEM employees increased from 1994 to 2003, particularly in mathematics and computer science, there was no evidence that the number of employees in engineering and technology-related fields did. University officials, researchers, and others cited the availability of mentors as having a large influence on the decision to enter STEM fields and noted that many students with STEM degrees find employment in non-STEM fields. The number of foreign workers declined in STEM fields, in part because of declines in enrollment in U.S. programs resulting from difficulties with the U.S. visa system. Key factors affecting STEM employment decisions include the availability of mentors for women and minorities and opportunities abroad for foreign workers.

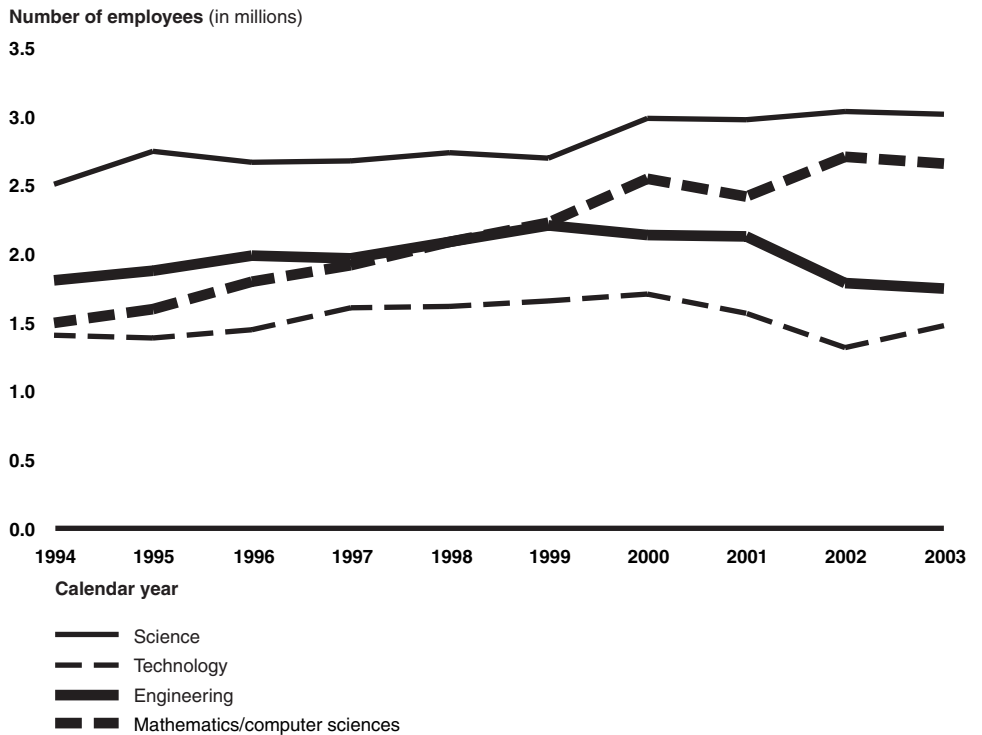
⁹ Seymour, Elaine, and Nancy M. Hewitt, *Talking about Leaving: Why Undergraduates Leave the Sciences*, Westview Press, 1997, Boulder, Colorado.

**STEM Employment Rose
Relative to Non-STEM
Employment, but in STEM
Fields the Proportion of
Women Remained about
the Same, Minorities
Continued to be
Underrepresented, and the
Number of Foreign
Workers Declined**

From 1994 to 2003, employment in STEM fields increased from an estimated 7.2 million to an estimated 8.9 million—representing a 23 percent increase, as compared to a 17 percent increase in non-STEM fields. While the total number of STEM employees increased, this increase varied across STEM fields. Coinciding with the spread of the Internet and the personal computer, employment increased by an estimated 78 percent in the mathematics/computer sciences fields and by an estimated 20 percent in the sciences. There was no evidence that the number of employees in the engineering and technology-related fields increased. Further, a 2006 National Science Foundation report found that about two-thirds of employees with degrees in science or engineering were employed in fields somewhat or not at all related to their degree.¹⁰ Figure 2 shows the estimated number of employees in STEM fields.

¹⁰ National Science Foundation, *Science and Engineering Indicators 2006*, Volume 1, National Science Board, January 13, 2006.

Figure 2: Estimated Numbers of Employees in STEM Fields from Calendar Years 1994 through 2003



Source: GAO calculations based upon CPS data.

Note: Estimated numbers of employees have confidence intervals of within +/- 9 percent of the estimate itself.

Women and minorities employed in STEM fields increased between 1994 and 2003, and the number of foreign workers declined. While the estimated number of women employees in STEM fields increased from about 2.7 million to about 3.5 million in this period, this did not result in a change in the proportion of women employees in the STEM fields relative to men. Specifically, women constituted an estimated 38 percent of the employees in STEM fields in 1994 and an estimated 39 percent in 2003, compared to 46 and 47 percent of the civilian labor force in 1994 and 2003, respectively. The estimated number of minorities employed in the STEM fields as well as the proportion of total STEM employees they constituted increased, but African-American and Hispanic employees remained underrepresented relative to their percentages in the civilian labor force. For example, in 2003, Hispanic employees constituted an estimated 10 percent of STEM employees compared to about 13 percent of the civilian labor force. Foreign workers traditionally had filled hundreds of thousands of positions, many in STEM fields, through the H-1B visa

program. In recent years, these numbers have declined in certain fields. For example, the number of approvals for systems analysis/programming positions decreased from about 163,000 in 2001 to about 56,000 in 2002.¹¹

**Key Factors Affecting
STEM Employment
Decisions Include
Mentoring for Women and
Minorities and
Opportunities Abroad for
Foreign Employees**

University officials and congressional commissions noted the important role that mentors play in encouraging employment in STEM fields and that this was particularly important for women and minorities.¹² One professor said that mentors helped students by advising them on the best track to follow for obtaining their degrees and achieving professional goals. In September 2000, a congressional commission reported that women were adversely affected throughout the STEM education pipeline and career path by a lack of role models and mentors.¹³

University officials and education policy experts told us that competition from other countries in educational or work opportunities and the more strict U.S. visa process since September 11, 2001, affected international employee decisions about studying and working in the United States. For example, university officials told us that students from several countries, including China and India, were being recruited by universities and employers in both their own countries and other countries as well as the United States. They also told us that they were also influenced by the perceived unwelcoming attitude of Americans and the complex visa process.

GAO has reported on several aspects of the visa process and has made several recommendations for improving federal management of the process. In 2002, we cited the need for a clear policy on how to balance national security concerns with the desire to facilitate legitimate travel when issuing visas.¹⁴ In 2005, we reported a significant decline in certain

¹¹ GAO, *H-1B Foreign Workers: Better Tracking Needed to Help Determine H-1B Program's Effects on U.S. Workforce*, GAO-03-883 (Washington, D.C.: Sept. 10, 2003).

¹² GAO, *Gender Issues: Women's Participation in the Sciences Has Increased, but Agencies Need to Do More to Ensure Compliance with Title IX*, GAO-04-639 (Washington, D.C.: Jul. 22, 2004).

¹³ Report of the Congressional Commission on the Advancement of Women and Minorities in Science, Engineering and Technology Development, *Land of Plenty: Diversity as America's Competitive Edge in Science, Engineering, and Technology*, September 2000.

¹⁴ GAO, *Border Security: Visa Process Should Be Strengthened as an Antiterrorism Tool*, GAO-03-132NI (Washington, D.C.: Oct. 21, 2002).

visa processing times and in the number of cases pending more than 60 days, and we also reported that in some cases science students and scholars can obtain a visa within 24 hours.¹⁵ However, in 2006, we found that new policies and procedures since the September 11 attacks to strengthen the security of the visa process and other factors have resulted in applicants facing extensive wait times for visas at some consular posts.¹⁶

More than 200 Federal Education Programs Exist to Promote STEM Careers, but Evaluation and Coordination Are Lacking

Officials from 13 federal civilian agencies reported spending about \$2.8 billion in fiscal year 2004 for 207 education programs designed to support STEM fields, but they reported little about the effectiveness of these programs.¹⁷ Although evaluations had been done or were under way for about half of the programs, little is known about the extent to which most STEM programs are achieving their desired results. Furthermore, coordination among the federal STEM education programs has been limited. However, in 2003, the National Science and Technology Council formed a subcommittee to address STEM education and workforce policy issues across federal agencies, and Congress has introduced new STEM initiatives as well.

¹⁵ GAO, *Border Security: Streamlined Visas Mantis Program Has Lowered Burden on Foreign Science Students and Scholars, but Further Refinements Needed*, GAO-05-198 (Washington, D.C.: Feb. 18, 2005).

¹⁶ GAO, *Border Security: Reassessment of Consular Resource Requirements Could Help Address Visa Delays*, GAO-06-542T (Washington, D.C.: Apr. 4, 2006).

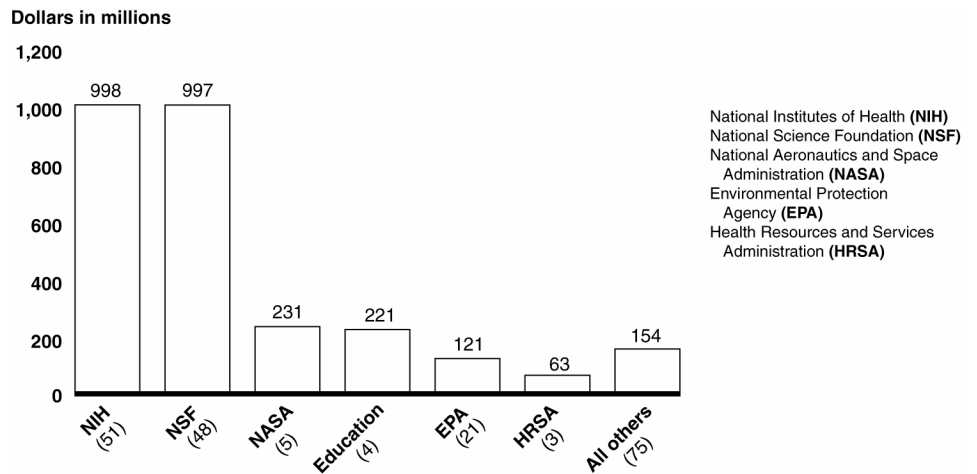
¹⁷ GAO asked agencies to include STEM and related education programs with one or more of the following as the primary objective: (1) attract and prepare students at any education level to pursue coursework in STEM areas, (2) attract students to pursue degrees (2-year degrees through postdoctoral degrees) in STEM fields, (3) provide growth and research opportunities for college and graduate students in STEM fields, (4) attract graduates to pursue careers in STEM fields, (5) improve teacher (pre-service, in-service, and postsecondary) education in STEM areas, and (6) improve or expand the capacity of institutions to promote or foster STEM fields. The Department of Labor's programs did not meet our selection criteria for STEM programs, and, as noted above, the Department of Defense did not submit a survey.

**Federal Civilian Agencies
Reported Spending
Billions for Over 200 STEM
Education Programs in
Fiscal Year 2004 and that
Evaluations Were
Completed or Under Way
for About Half**

Officials from 13 federal civilian agencies reported that approximately \$2.8 billion was spent in fiscal year 2004 on 207 STEM education programs.¹⁸ The funding levels for STEM education programs among the agencies ranged from about \$998 million for the National Institutes of Health to about \$4.7 million for the Department of Homeland Security, and the numbers of programs ranged from 51 to 1 per agency, with two agencies—NIH and the National Science Foundation—administering nearly half of the programs. Most STEM education programs were funded at \$5 million or less, but 13 programs were funded at more than \$50 million, and the funding reported for individual programs varied significantly. For example, one Department of Agriculture-sponsored scholarship program for U.S. citizens seeking bachelor's degrees at Hispanic-serving institutions was funded at \$4,000, and one NIH grant program designed to develop and enhance research training opportunities was funded at about \$547 million. Figure 3 shows the funding and number of STEM education programs by federal civilian agency.

¹⁸ The program funding levels, as provided by agency officials, contain both actual and estimated amounts for fiscal year 2004.

Figure 3: Federal STEM Education Programs and Funding by Agency, Fiscal Year 2004



Source: GAO survey responses from 13 federal agencies.

According to the agency responses to GAO's survey, most STEM education programs had multiple goals, and one goal was to attract students or graduates to pursue STEM degrees and occupations. Many STEM programs also were designed to provide student research opportunities, provide support to educational institutions, or improve teacher training. In order to achieve these goals, many of the programs were targeted at multiple groups and provided financial assistance to multiple beneficiaries. STEM education programs most frequently provided financial support for students or scholars, and several programs provided assistance for teacher and faculty development as well. U.S. citizenship or permanent residence was required for the majority of programs. Table 1 presents the most frequent program goals and types of assistance provided.

Table 1: Most Frequent Federal Program Goals and Types of Assistance Provided

Most frequent program goals (in descending order)	Most frequent types of assistance (in descending order)
<ul style="list-style-type: none">•Attract students to pursue degrees (2-year through Ph.D.)•Attract graduates to pursue careers in STEM fields•Attract and prepare students at any education level to pursue coursework in STEM areas•Provide growth and research opportunities for undergraduate and graduate students in STEM fields•Improve or expand the capacity of institutions to promote or foster STEM fields•Improve teacher education in STEM areas	<ul style="list-style-type: none">•Financial support for students or scholars•Support for teacher and faculty development•Institutional support to improve educational quality•Institutional physical infrastructure support

Source: GAO survey responses from 13 federal agencies.

Note: Information on program goals and types of assistance was not provided by the Department of Defense.

Agency officials reported that evaluations—which could play an important role in improving program operations and ensuring an efficient use of federal resources—had been completed or were under way for about half of the STEM education programs. However, evaluations had not been done for over 70 programs that were started before fiscal year 2002, including several that had been operating for over 15 years. For the remaining over 30 programs that were initially funded in fiscal year 2002 or later, it may have been too soon to expect evaluations.

Federal Coordination Has Been Limited, but a Federal Group Was Established in 2003 to Help Coordinate STEM Education Programs among Federal Agencies

Coordination of federal STEM education programs has been limited. In January 2003, the National Science and Technology Council's Committee on Science (COS) established a subcommittee on education and workforce development. According to its charter, the subcommittee is to address education and workforce policy issues and research and development efforts that focus on STEM education issues at all levels, as well as current and projected STEM workforce needs, trends, and issues. The subcommittee has working groups on (1) human capacity in STEM areas, (2) minority programs, (3) effective practices for assessing federal efforts, and (4) issues affecting graduate and postdoctoral researchers.

NSTC reported that, as of June 2005, the subcommittee had a number of accomplishments and had other projects under way related to attracting students to STEM fields. For example, it had surveyed federal agency

education programs designed to increase the participation of women and underrepresented minorities in STEM studies, and it had coordinated the Excellence in Science, Technology, Engineering, and Mathematics Education Week activities, which provide an opportunity for the nation's schools to focus on improving mathematics and science education. In addition, the subcommittee is developing a Web site for federal educational resources in STEM fields and a set of principles that agencies could use in setting levels of support for graduate and postdoctoral fellowships and traineeships.

Congress Created New Grants to Help Needy Students Obtain STEM Degrees and Established a Council to Determine the Effectiveness of Federal STEM Programs and Provide Coordination

In passing the Deficit Reduction Act of 2005,¹⁹ Congress created a new source of grant aid for students pursuing a major in the physical sciences, the life sciences, the computer sciences, mathematics, technology, engineering, or a foreign language considered critical to the national security of the United States. These National Science and Mathematics Access to Retain Talent Grants—or SMART Grants—provide up to \$4,000 for each of 2 academic years for eligible students. Eligible students are those who are in their third or fourth academic year of a program of undergraduate education at a 4-year degree-granting institution, have maintained a cumulative grade point average of 3.0 or above, and meet the eligibility requirements of the federal government's need-based Pell Grant program.²⁰ Education expects to provide \$790 million in SMART Grants to over 500,000 students in academic year 2006–2007.

Congress also established an Academic Competitiveness Council in passing the Deficit Reduction Act of 2005. The council is composed of officials from federal agencies with responsibilities for managing existing federal programs that promote mathematics and science and is chaired by the Secretary of Education. Among the statutory duties of the council are to (1) identify all federal programs with a mathematics and science focus, (2) identify the target populations being served by such programs, (3) determine the effectiveness of such programs, (4) identify areas of overlap or duplication in such programs, and (5) recommend ways to efficiently integrate and coordinate such programs. Congress also charged the council to provide it with a report of its findings and recommendations by early 2007. In an April 2006 hearing before the House Committee on

¹⁹ Pub. L. No. 109–171 (2006).

²⁰ The Federal Pell Grant Program promotes access to postsecondary education by providing need-based grants to low-income students.

Education and the Workforce, the Secretary of Education testified that she and President Bush convened the first meeting of the council on March 6, 2006.

Concluding Observations

While the total numbers of STEM graduates have increased, some fields have experienced declines, especially at the master's and doctoral levels. Given the trends in the numbers and percentages of graduates with STEM degrees—particularly advanced degrees—and recent developments that have influenced international students' decisions about pursuing degrees in the United States, it is uncertain whether the number of STEM graduates will be sufficient to meet future academic and employment needs and help the country maintain its technological competitive advantage. Moreover, although international graduate applications increased in academic year 2005–2006 for the first time in 3 years, it is too early to tell if this marks the end of declines in international graduate student enrollment. In terms of employment, despite some gains, the percentage of women in the STEM workforce has not changed significantly, minority employees remain underrepresented relative to their employment in the civilian labor force, and many graduates with degrees in STEM fields are not employed in STEM occupations. Women now outnumber men in college enrollment, and minority students are enrolling in record high levels at the postsecondary level as well. To the extent that these populations have been historically underrepresented in STEM fields, they provide a yet untapped source of STEM participation in the future.

To help improve the trends in the numbers of graduates and employees in STEM fields, university officials and others made several suggestions, such as increasing the federal commitment to STEM education programs. However, before expanding the number of federal programs, it is important to know the extent to which existing STEM education programs are appropriately targeted and making the best use of available federal resources—in other words, these programs must be evaluated—and a comprehensive evaluation of federal programs is currently nonexistent. Furthermore, the recent initiatives to improve federal coordination, such as the American Competitiveness Council, serve as an initial step in reducing unnecessary overlap between programs, not an ending point. In an era of limited financial resources and growing federal deficits, information about the effectiveness of these programs can help guide policymakers and program managers in coordinating and improving existing programs as well as determining areas in which new programs are needed.

Mr. Chairman, this concludes my prepared statement. I would be pleased to respond to any questions that you or other members of the Committee may have.

GAO Contact and Acknowledgments

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