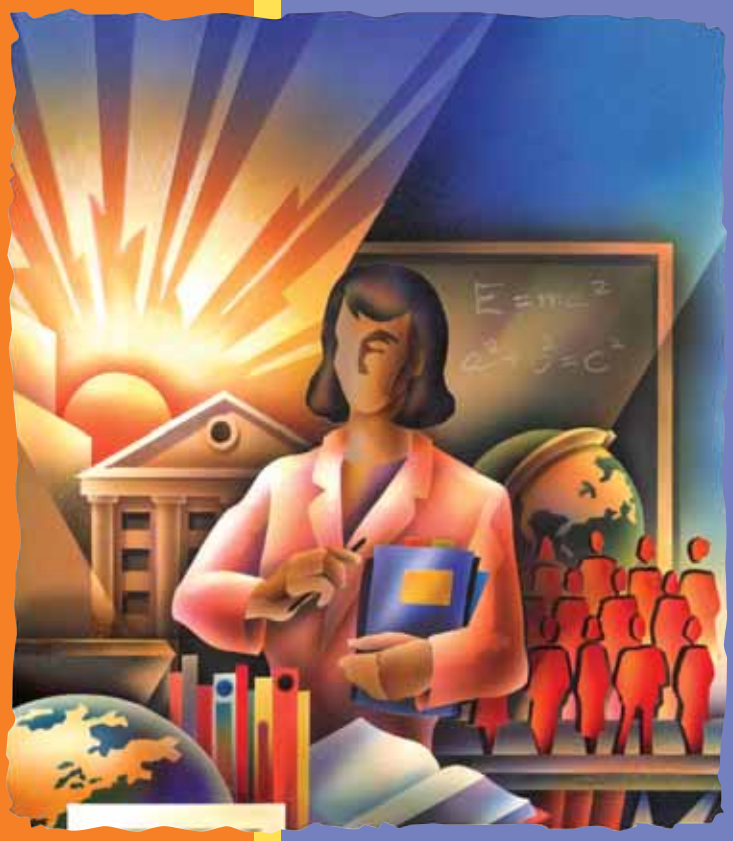
FOURTH IN A SERIES

THE UNFINISHED AGENDA: ENSURING SUCCESS FOR STUDENTS OF COLOR

Increasing the Success of Minority Students in Science and Technology



AMERICAN COUNCIL ON EDUCATION
The Unifying Voice for Higher Education

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Increasing the Success of Minority Students in Science and Technology

Eugene Anderson
American Council on Education

Dongbin Kim
University of Kansas

Illustration by Boris Lyubner

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American Council on Education

American Council on Education
One Dupont Circle NW
Washington, DC 20036

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Foreword

For more than three decades, many of America's colleges and universities have made determined efforts to create racially diverse campuses. Making continued progress on enrolling and graduating underrepresented minority students is a perennial issue on many campuses. Ensuring that students of color are academically successful is the ultimate goal. In 2003, the highly visible Supreme Court cases involving admissions decisions at the University of Michigan called additional attention to an already important issue. Although most institutions effectively attract and admit students of color, many fall short in fashioning a successful undergraduate experience for these same students. Access to higher education for students of color, while remaining an absolutely necessary objective for colleges and universities, is only part of the equation. The difficult fact remains that it does a student little or no good to matriculate if he or she does not succeed, regardless of institution or program.

To this end, the American Council on Education (ACE), with the support of the Rockefeller Foundation, is seeking to make the *success* of students of color a high priority for institutions. *Success* is broadly defined, to include not only persistence and graduation rates, but also other indicators, such as equity in GPAs, participation in honor societies and awards, and postgraduate experiences (such as enrollment in professional and graduate degree programs). This paper is the fourth in a series that addresses different dimensions of ensuring the success of students of color. This paper provides important data regarding the persistence and success of African-American and Hispanic students in science and technology. The first paper in the series argued for the use of equity indicators and hard data to bring about institutional change that advances campus diversity. The second outlined leadership advice for presidents, particularly newly appointed ones, regarding advancing a campus diversity agenda. The third paper in the series provided a legal framework for important questions presidents should consider as they move forward using different strategies to ensure the academic success of students of color.

We encourage readers to consider the ways in which the findings presented here challenge current common wisdom and point the ways to new and different efforts to better ensure the persistence and graduation of underrepresented students of color.

Peter D. Eckel
Director, Programs and Initiatives, Center for Effective Leadership
Series Editor, *The Unfinished Agenda: Ensuring Success for Students of Color*

Introduction

The nation's changing demographics and continued need to remain globally competitive make it clear that colleges and universities must increase the number of Hispanics and African Americans earning degrees in science, technology, engineering, and math (the STEM fields). Thirty-nine percent of people under age 18 in the United States are persons of color and this percentage will continue to increase (U.S. Census Bureau, 2000), placing young people of color at the vanguard of the next generation. It is upon this generation that the nation places its hopes for continued economic competitiveness in the Information Age.

To many observers, the difficulty of this challenge stems from the belief that African-American and Hispanic students do not enter higher education interested in studying the STEM fields at the same rate as whites and Asian Americans. Another commonly held belief is that traditionally underrepresented minority students do not have the academic preparation necessary to move beyond the first-level STEM courses that are considered filters, moving inadequately prepared students out of the major. An examination of the number of bachelor's degrees awarded in STEM fields over the past 10 years appears to support these beliefs. In 2000–01, only about 13 percent of bachelor's degrees awarded to African Americans and Hispanics were in the STEM fields, compared with 31 percent for Asian Americans and 16 percent for whites. These figures have changed little over the past decade. Numbers such as these, coupled with the beliefs described above, have led to a variety of efforts to build interest in the STEM fields among African Americans and Hispanics.

However, this assessment oversimplifies the problem and masks its origins because it assumes that low numbers of minority graduates in the STEM fields continue to be the result of low numbers of African Americans and Hispanics entering college with interest in these fields. A closer look at the data reveals that African Americans and Hispanics enter higher education with the same level of interest in the STEM fields as their peers, but that they fail to persist in these majors at the same rate as their white and Asian-American classmates. This monograph examines the path of students in the STEM fields, focusing on persistence toward

bachelor's degrees, by race and ethnicity. It shows that African-American and Hispanic students entering four-year institutions major in the STEM fields at similar rates as white and Asian-American students, that they initially persist, but that they struggle in their final years to complete a bachelor's degree. The question posed by this finding is: How might colleges and universities increase the graduation rates of African-American and Hispanic students in the STEM fields? We explore this question by examining data that provide clues as to why African-American and Hispanic students find it difficult to complete degrees in the STEM fields.

Developing the Nation's Scientific Competitiveness

One of the main roles of U.S. higher education today is to educate and train the next generation of citizens who will help the nation maintain its competitiveness in an increasingly global marketplace. Competition from abroad is increasing, as emerging economic powers such as China and India produce more people trained in the STEM fields. Reports of the actual numbers vary, but commonly cited statistics suggest that each year, for every two bachelor's degree in engineering conferred to an American by a U.S. institution, China awards five such degrees—about 200,000 compared with around 70,000.[1]

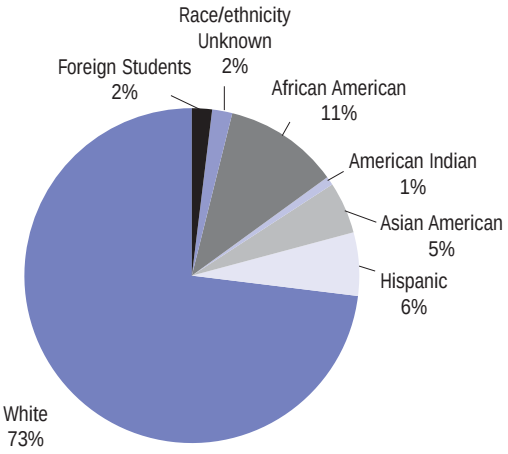
The challenge of developing a scientifically skilled workforce is complicated by the increasing diversity of the nation. Each year's entering cohort of college students includes more persons of color than the previous class, each seeking an education that will equip them with the skills to be successful. The United States has made tremendous strides in its efforts to increase minority access to postsecondary education. In 1970, only a half-million African Americans were enrolled in U.S. postsecondary education. More than three decades later, that number has increased to nearly 2 million. In 1980, less than a half-million Hispanics were enrolled in college in the United States. Today, almost three times that number are enrolled in colleges and universities across the nation. However, the increased access of traditionally underrepresented groups to higher education is only part of the story. Lower rates of degree attainment among certain minority groups continue. African Americans and Hispanics continue to be significantly less likely to earn a bachelor's degree in six years than either whites or Asian Americans.

[1] Bialik, C. (2005, August 30). *Outsourcing fears help inflate numbers*. Wall Street Journal Online. See www.collegejournal.com/globalcareers/newstrends/20050830-bialik.html?refresh=on.

Students and Their Fields of Study

This report is based upon data from a longitudinal study conducted by the U.S. Department of Education's National Center for Education Statistics (NCES), the Beginning Postsecondary Students Longitudinal Study (BPS 1995–96 to 2000–01).[2] It draws upon a nationally representative sample of approximately 12,000 students who began college in fall 1995 and follows them over six years, tracking their enrollment status, attendance status, college experience, and numerous other variables. These students were interviewed in the spring and summer of 1998, approximately three years after they first enrolled in 1995–96. A second and final follow-up was conducted in the spring and summer of 2001. For the purpose of this report, we focus on undergraduates who began their postsecondary education in 1995 at four-year institutions and were seeking a bachelor's degree.

Figure 1: Distribution of First-Time, First-Year Undergraduates, by Race/Ethnicity: 1995



Source: U.S. Department of Education, National Center for Education Statistics, Integrated Postsecondary Education Data System (IPEDS), Enrollment Survey, 1995.

For this cohort (as illustrated in **Figure 1**), nearly three of four of the more than 1 million entering undergraduates were white. American minorities comprised 23 percent of the study's sample. This distribution of entering undergraduates resembles the racial/ethnic breakdown of the entire undergraduate population at four-year institutions in 1995, which totaled about 6.7 million students. The racial/ethnic composition of higher education is similar to the larger national population, except for Hispanics who were underrepresented in higher education, comprising only 6 percent of the student population, as compared with 10 percent of the national population.[3]

[2] All data in this report, unless noted, are from the U.S. Department of Education, National Center for Education Statistics, Beginning Postsecondary Students Longitudinal Study, 1996/2001.
[3] Campbell, P. R. (1996). *Population projections for states by age, sex, race, and Hispanic origin: 1995 to 2025.* U.S. Bureau of the Census, Population Division, PPL-47.

Upon enrolling, students make choices that have a tremendous effect on their success. They decide the number of courses they will take; what they will study; how often they will interact with their faculty; the balance between study, work, and play; and how engaged they will be with their institution. One of the most significant decisions students must make is deciding what field of study to select as their major. Although most institutions do not require students to select a major immediately, many students begin college with a strong preference for a specific field of study.

Colleges and universities offer hundreds of majors, ranging from acoustics to zoology, to meet the interest of students, fulfill their missions, and serve the needs of their surrounding region. In this essay, we aggregate majors into seven broad categories: business, education, health, humanities, social/behavioral sciences, STEM, and technical/professional (for definitions of fields, see Appendix A). A key finding is the large percentages of African-American and Hispanic students who began college at four-year institutions interested in majoring in the STEM fields, 18.6 percent and 22.7 percent, respectively (see **Table 1**).[4] In 1995–96, Hispanics were more likely to major in the STEM fields than any other group except Asian Americans. The near-parity between the percentage of Hispanics and Asian Americans majoring in the STEM fields is surprising because Hispanics, despite enrolling at four-year institutions in similar numbers to Asian Americans, earned about 10,000 fewer bachelor's degrees in the STEM fields.[5]

Table 1: Major Field of Study, Beginning Postsecondary Students, by Race/Ethnicity: 1995–96

	Whites	African Americans	Hispanics	Asian Americans
Major	%	%	%	%
Humanities	10.3	7.1	8.1	7.0
Social Sciences	8.8	7.5	9.6	6.0
STEM	18.0	18.6	22.7	26.4
Education	8.1	6.5	6.8	1.0
Business	10.3	10.9	15.2	10.0
Health	6.8	7.1l	5.9	10.0
Technical/Professional	8.7	6.1	7.8	3.0
Undecided	28.9	36.4	23.9	36.8

[4] Designation of major during first year is based on both formal and informal (intended) field of study.
[5] U.S. Department of Education, National Center for Education Statistics, Integrated Postsecondary Education Data System (IPEDS), Completion Survey, 2001.

Differences among racial/ethnic groups and major field of study also exist in education, business, and technical fields. Very few Asian Americans entered four-year institutions interested in majoring in education (1 percent) or technical/professional fields (3 percent), such as architecture, journalism, agriculture, and home economics, compared with from 6 percent to 9 percent for other groups. At the beginning of their college careers, Hispanics were significantly more likely than other groups to major in business. The percentage of first-year students in each racial/ethnic group in 1995–96 majoring in humanities, social sciences, and health were similar, differing by 3 percentage points or fewer. Importantly, most institutions do not require (and many do not allow) students to declare a major during their first year of college, so it is not surprising that a large share of students in each racial/ethnic group were undecided (between 24 percent and 37 percent of the cohort).

Other key differences exist beyond race and ethnicity. For example, more than 60 percent of students majoring in the STEM fields were males; in education, men made up only 23 percent of students (see **Table 2**). The majority of undergraduates who began college at a four-year institution in 1995–96 had at least one parent who attended college, but the majority of students majoring in health (56.5 percent) and business (51.5 percent) were first-generation college attendees. There is much less variation across the fields of study in age, dependency status, and attendance status. Approximately 88 percent of all undergraduates in this cohort were 19 or younger when they began college. Nearly all were dependent students and attended college full time during their first year.

Table 2: Student Characteristics, by Major

	Traditional Age	Male	Dependent	First Generation	Delayed Enrollment	Attendance Status (Full Time)
Major	%	%	%	%	%	%
All Students	87.6	43.9	93.0	47.1	19.7	80.5
Humanities	87.2	38.2	92.7	44.4	17.9	78.6
Social Sciences	82.2	35.5	89.9	48.8	25.5	79.4
STEM	90.0	61.3	94.6	46.4	19.0	83.7
Education	89.6	23.1	93.6	50.5	13.1	81.9
Business	91.6	47.0	95.2	51.5	17.3	84.4
Health	87.1	25.2	90.4	56.5	17.2	81.3
Technical/Professional	83.3	53.3	93.3	47.1	27.9	78.2
Undecided	86.9	42.8	92.3	43.3	19.9	77.9

Student Persistence in the STEM Fields

Understanding why African-American and Hispanic students who major in the STEM fields graduate at different rates from their white and Asian-American counterparts requires an examination of the effect a student's major field of study might have on his or her persistence toward a degree. The overall graduation rates of African-American and Hispanic students lag behind those of whites and Asian Americans. Sixty-two percent of degree-seeking undergraduates who began at a four-year institution in 1995–96 earned a bachelor's degree within six years.[6]

Table 3: Distribution of Majors, by Persistence Rates (Bachelor's Degree Earned) Above and Below Overall Average, by Race/Ethnicity of 1995–96 Beginning Postsecondary Students: Spring 2001

	All Students	African Americans	Asian Americans	Hispanics	Whites
Above the Average			Technical/ Professional		
	STEM		STEM		STEM
	Social/Behavioral sciences	Social/Behavioral sciences			Social/Behavioral sciences
		Humanities	Humanities	Humanities	
	Education	Education			Education
	Health	Health	Health		Health
	Business	Business	Business	Business	Business
Group Persistence Rate Average					
Below the Average	Technical/ Professional	Technical/ Professional		Technical/ Professional	Technical/ Professional
			Social/Behavioral sciences	Social/Behavioral sciences	
		STEM		STEM	
	Humanities				Humanities
			Health		
			Education		

[6] This report uses a six-year timeframe because a significant portion of degree-seeking undergraduates who began college at four-year institutions did not attend full time (19.5 percent). Also, because a significant percentage of students attended more than one institution during their academic careers, we used degree completion at any postsecondary institution, rather than just from the institutions that students first attended.

Fewer than half of African-American and a little over half of Hispanic first-year students in 1995–96 had persisted to a bachelor's degree by spring 2001 (see Table 6 in Appendix B). As **Table 3** (on page 7) shows, success varied by field of study. In the STEM fields, Hispanic and African-American students had persistence rates below the average overall persistence rate for their respective racial/ethnic group.

The variation of student success in the STEM fields by race/ethnicity raises important questions about the characteristics of students selecting various majors, the experience of those students in these fields of study, and the financial implications for students who select a particular major but drop out of college.

The Path to a STEM Degree

Despite concerns about a possible lack of interest among students in the STEM fields, the largest group of first-year students in 1995–96 who selected a major field of study chose these scientific and technological fields. And although students often change their majors, nearly two-thirds of students initially choosing the STEM fields remained in that major three years later. (Only business had a higher percentage of students not changing to another major, 73.5 percent.) However, the graduation rates for students from different racial/ethnic groups in STEM varied, suggesting that something occurs later in students' academic careers that impedes the success of different groups of students. In 2003, only 7 percent of bachelor's degrees awarded to African Americans and Hispanics were in the STEM fields, significantly less than the 19 percent and 23 percent, respectively, of African-American and Hispanic students interested in the STEM fields during their first year. Is the reason for the significant loss of African-American and Hispanic students in the STEM fields simply that these students do not make the grade, or is the picture more complex? To answer this question, it is necessary to chart the path of students who begin their postsecondary education interested in studying a STEM field.

A Unique Journey

One might suspect that African-American and Hispanic students majoring in the STEM fields often get derailed during their first year by classes typically called "filter" or "weeder" courses. However, the data suggest that these students take an unexpected detour much later in their studies.

Looking at the 1995–96 cohort, among degree-seeking students who began at four-year institutions, Hispanic students majored in the STEM fields at rates nearly as high as Asian-American students (22.7 percent, compared with 26.4 percent, respectively). White and African-American students selected STEM fields as a major at almost the same rate, about 18 percent. Three years later (in spring 1998), the percentage of these students in each racial/ethnic group who continued studying STEM fields was nearly identical. Fifty-seven percent of whites and Asian Americans who initially selected STEM, and 56 percent of African Americans and Hispanics, remained in the STEM fields (see **Table 4**, on page 10).

Table 4: The Path of STEM Majors, by Race/Ethnicity: 1995–96 to 2001				
1995–96	BY SPRING 1998		BY SPRING 2001	
African Americans & Hispanics Majoring in STEM Fields	Enrolled at four-year institution, majoring in STEM	55.7%	Attained bachelor's degree	62.5%
			No degree, not enrolled at four-year institution	8.8%
			No degree, enrolled at four-year institution	28.8%
	Enrolled at four-year institution, not majoring in STEM	22.5%		
	Not enrolled at any institution, last major was in STEM	10.7%		
	Not enrolled at any institution, last major was not in STEM	11.0%		
Whites Majoring in STEM Fields	Enrolled at four-year institution, majoring in STEM	57.1%	Attained bachelor's degree	86.7%
			No degree, not enrolled at four-year institution	4.8%
			No degree, enrolled at four-year institution	8.6%
	Enrolled at four-year institution, not majoring in STEM	25.3%		
	Not enrolled at any institution, last major was in STEM	9.5%		
	Not enrolled at any institution, last major was not in STEM	8.0%		
Asians Majoring in STEM Fields	Enrolled at four-year institution, majoring in STEM	57.2%	Attained bachelor's degree	94.8%
			No degree, not enrolled at four-year institution	2.0%
			No degree, enrolled at four-year institution	3.2%
	Enrolled at four-year institution, not majoring in STEM	23.5%		
	Not enrolled at any institution, last major was in STEM	6.2%		
	Not enrolled at any institution, last major was not in STEM	13.1%		

It was after their third year when their journeys began to differ, with the largest difference being the sizable number of African-American and Hispanic students who were no longer making timely progress. By spring 2001, 62.5 percent of African-American and Hispanic students who had majored in the STEM fields in 1998 obtained their degree in that area, far lower than the 94.8 percent of Asian-American and 86.7 percent of white students in the same cohort who had earned their degrees in STEM areas. The majority of those who did not obtain a STEM degree had not dropped out; they were still enrolled and working toward a degree, but at a much slower pace.

What happened to the 28.8 percent of African-American and Hispanic students who began in the STEM fields, persisted past their third year, and were still enrolled, but had not yet obtained a degree? Examining how these non-completers differ from their peers who earned a bachelor's degree within six years may provide important clues to understand the persistence of African Americans and Hispanics in the STEM fields. To explore this issue more deeply, we combined racial/ethnic groups in order to compare the non-completers with the completers, because of the small number of students in the study sample.

Completers and Non-Completers

We found that all the students portrayed in Table 4 who had earned a bachelor's degree by spring 2001 in the STEM fields were significantly better prepared for postsecondary education than those who had not earned a degree but were still enrolled. Nearly 42 percent of completers in the STEM fields took what is considered a highly rigorous curriculum in high school, compared with only 18 percent of non-completers.[7]

Age at time of entry to postsecondary education was also a difference among completers and non-completers. Nearly all of the completers were younger than 19 when they entered college in 1995–96 (97.6 percent, compared with 83.9 percent of the non-completers).

Completers in the STEM fields also differed in level of parental education and income. Nearly two of every three completers (64.4 percent) had at least one parent with a bachelor's degree or higher, compared with 38 percent of non-completers. Completers also came from families with higher income levels. Forty-seven percent of completers came from families with parental income in the highest third of the national average, compared with only 28.1 percent of non-completers.

The differences between completers and non-completers continued in several key areas once both groups of students entered college. Three of every four completers in the STEM fields were enrolled exclusively on a full-time basis during their college years. The remaining 25 percent of completers varied their enrollment between full and part time during their collegiate careers. Among the non-completers, attendance patterns were divided almost evenly between full-time attendance (49.3 percent) and a mixture of full- and part-time enrollment (50.7 percent).

[7] A highly rigorous high school curriculum consists of four years each of English and math, and three years each of a foreign language, science, and social science. This curriculum also requires at least one Advanced Placement course, as well as pre-calculus, biology, chemistry, and physics.

Non-completers also were more likely to work 15 hours or more a week (42.6 percent, compared with 27.1 percent among completers). Thus, the higher percentage of non-completers studying less than full time is likely due to employment. Financial need partially explains why students work more while enrolled. This also holds true for the students in the STEM fields. The non-completers majoring in the STEM fields were far less likely to receive financial aid grants exceeding $5,000 during their first year of study (7.6 percent, compared with 38.5 percent of completers).

Completers in the STEM fields also differed in their level of involvement at their institution, both academically and socially. Completers were twice as likely to have the highest level of social integration at their institution (30.3 percent, versus 13.9 percent). The difference in level of academic integration was much smaller—40.6 percent of completers had the highest level of academic integration, compared with 32.4 percent of non-completers.

These findings suggest several key questions for further study. Are these differences between students in the STEM fields who obtained their degrees and those who did not the definitive explanation for their status? Does each of these factors matter for each racial/ethnic group, or are some factors more powerful for particular groups? The next section attempts to answer these important questions.

When Persistence Varies by Major

Previous research on persistence identified three distinct sets of factors important for student success, regardless of major field of study: (1) who students are before they enroll in a postsecondary institution, (2) what students do to prepare for higher education, and (3) what they do once enrolled at a college or university. Each of these three elements strongly influences the success of college students of all racial/ethnic groups, but the research is inconclusive regarding the extent to which or how each factor matters. That said, it is important to understand why each element is important to student persistence, regardless of major or race/ethnicity.

The variation in persistence rates among racial/ethnic groups is related to a variety of economic factors, as well as academic preparation (Adelman, 1999 & 2004; St. John et al., 1991). The economic status of a student's family is the most important of these factors, because it affects a student's access to high-quality primary and secondary education, as well as their families' ability to pay for college. Low-income students are less likely to have completed a rigorous high school curriculum than those from middle- and upper-income backgrounds (King, 2002), which, as Adelman's research (1999) shows, is one of the most important factors influencing college success. Because African Americans and Hispanics are more likely to be low-income than whites, socioeconomic factors that affect persistence can inaccurately appear to be related to racial or cultural differences. What really matters, according to Adelman (2005), is socioeconomic status, as it has a stronger relationship with college access and success than race/ethnicity. Additionally, because income is related to parents' education level, the difference in family income means that African-American and Hispanic students are less likely to have a parent who attended college. The knowledge and familiarity of a parent who attended college can be helpful for students as they navigate the challenging road to college and beyond, to degree completion.

The economic status of a student's family also influences a student's college financing options, which is related to student retention and graduation. For example, students who choose to enroll only part time in order to work more and borrow less negatively affect their degree completion rate. The combination of part-time attendance and working more than 15 hours per week increases a student's chances of dropping out (King, 2002). A decline in the purchasing power of the Pell Grant

continues to push more low-income students into having to choose between borrowing more and working more. On average, low-income freshmen have $2,400 more unmet financial need than middle- and upper-income freshman (King, 2002).

Finally, persistence rates vary among racial/ethnic groups because of what students do upon matriculation. Research suggests that persistence in college is related to a student's ability to build academic and social connections within their institutions (Tinto, 1987 & 1993; Pascarella and Terenzini, 1991). Students typically build these connections by becoming involved in campus organizations or study groups, and from contact with professors outside the classroom. Academic and social integration can be more of a challenge for students of color at majority white institutions, because the students and faculty who surround them do not resemble the communities from which they came and with which they may be most comfortable.

Previous research convincingly demonstrates that, together, these three elements clearly explain why persistence rates vary by racial/ethnic groups. However, to understand the variation in persistence among those majoring in the STEM fields, it is necessary to examine whether major field of study also plays an important role in student persistence, or whether the factors that predict persistence for students in all fields of study apply equally to those in the STEM fields.

To address these complex issues, we conducted statistical analysis controlling for the variation among all variables. This approach is important because, by controlling for all the variables, we are able to learn if the difference in completing a bachelor's degree is related to, for example, high school curriculum, parental income, or race. Statistical analysis of the relationship among major field of study, persistence, and several key background and post-enrollment variables by race/ethnicity revealed some surprising results (for detailed findings on each variable, see Table 7 in Appendix B). The relationship between major field of study and persistence was not extensive and there was no statistically significant variation in degree completion by major field of study (except in business for Hispanics and in health for African Americans).[8] Therefore, majoring in the STEM fields does not by itself explain the significant variations in degree completion rates among all of the various racial/ethnic groups (see Table 6 in Appendix B). The variables strongly related to persistence for most groups were full-time attendance, hours worked, and rigor of high school curriculum. White, African-American, and Hispanic students who attended full-time were more likely to have earned a bachelor's degree within six years of entry. White, Hispanic, and Asian-American students were less likely to graduate if they had not taken a highly rigorous high school curriculum.

Based on our analysis, it is clear that besides attendance status, hours worked, and rigor of high school curriculum, no other single factor affects the persistence of students of color in the STEM fields. Instead, a combination of unique variables for each racial/ethnic group influences their success. In other words, ensuring success for students of color in the STEM fields depends upon several predictors.

[8] African-American students majoring in the health fields were more likely to complete a bachelor's degree than African-American students majoring in the STEM fields. Hispanic students majoring in business were more likely to complete a bachelor's degree than Hispanic students majoring in the STEM fields.

Conclusion: Investing in the Right Support for Students of Color

Efforts by higher education institutions, government agencies such as NASA, and various professional organizations such as the National Society of Black Engineers to recruit more students of color into science, technology, engineering, and math fields have proven successful, with African Americans and Hispanics as interested in the STEM fields as are whites and Asian Americans. The challenge now is to move traditionally underrepresented students in the STEM fields toward timely degree completion by supporting these students throughout their undergraduate careers. Although the discovery that few of these students drop out is encouraging, the concern remains that large numbers of African-American and Hispanic students who begin in the STEM fields do not attain their bachelor's degree within six years.

However, the findings offered here suggest that this challenge is not specific to the STEM fields, and the strategies for increasing minority student degree completion in the STEM fields are the same as those for increasing success in any other major. That said, key differences related to race/ethnicity remain. **Table 5** shows the positive and negative predictors of degree completion for each racial/ethnic group, including

Table 5: Factors Influencing Student Persistence, by Race/Ethnicity

Student Race/Ethnicity	Positive Predictors of Obtaining a Bachelor's Degree	Negative Predictors of Obtaining a Bachelor's Degree
African American	At least one parent with a bachelor's degree or higher, full-time attendance, grant aid of more than $5,000, working 14 hours or fewer a week, and majoring in health.	
Asian American		Taking a "not rigorous" high school curriculum, and delaying enrollment.
Hispanic	Full-time attendance, and majoring in business.	Taking a "new basics" high school curriculum, and working 15 hours or more a week.
White	Not first-generation college attendee, full-time attendance, and grant aid of more than $5,000.	Did not take "highly rigorous" high school curriculum, low parental income, and working 15 hours or more a week.

student background and campus variables.

The key is for higher education institutions to know how to better identify those students who need support—and what type of support, both academic and financial, would be most helpful—in order to be successful in the STEM fields. The findings suggest that students from all racial/ethnic backgrounds can succeed in STEM fields. For the majority of students, both white and of color, inadequate academic preparation is only the first challenge they face. Many students are unable to attend on a full-time basis consistently, because they work long hours while enrolled. However, students with particular characteristics are of higher risk than others. For instance, among African Americans, support should be focused on first-generation college attendees. Among Hispanic and white students, focus should be given to students who did not take a rigorous high school curriculum. For white students, attention also should be paid to those from low-income families.

The biggest challenge for institutions seeking to improve student persistence is encouraging students to work less and attend full time consistently. This is a major challenge because these are two areas that institutions can do little to control. Increased financial aid may help reduce work load, but King (2002) found that greater financial aid need is not the sole reason why students work long hours. As King (2002) suggested, institutions should provide academic advising *and* financial aid options that encourage students to enroll full time and reduce their need to work more than 14 hours a week.

The talent pool needed to increase the number of bachelor's degrees produced in the STEM fields already exists in colleges and universities across the nation. The nation should focus on this talented pool of minority students who are majoring in the STEM fields but struggling to earn their degrees. The challenge is costly, but the benefit to the nation far outweighs the cost. Because of the national importance of Americans trained in the STEM fields, institutions should seek support from state legislators, the federal government, and corporate world, especially the technology industry. With more support from these outside forces and elevated awareness of the problem at hand, institutional leaders should be able to increase the size of the science and technology workforce, while simultaneously diversifying this important sector.

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Appendices

Appendix A: Definitions of Major Fields of Study

Business: Accounting, finance, secretarial, data processing, business/management, public administration, marketing/distribution, business support, and international relations.

Education: Early childhood, elementary, secondary, special, or physical education; leisure studies; library/archival sciences.

Health: Nursing, nurse assisting, community/mental health, medicine, physical education/recreation, audiology, clinical health, dentistry, veterinary medicine, health/hospital, public health, dietetics, and other/general health.

Humanities: English, liberal arts, philosophy, theology, art, music, speech/drama, history/fine arts, area studies, African-American studies, ethnic studies, foreign languages, liberal studies, and women's studies.

Social/behavioral sciences: Psychology, economics, political science, American civilization, clinical pastoral care, social work, anthropology/archaeology, history, and sociology.

STEM: Mathematics, statistics, computer/information science, computer programming, electrical, chemical, mechanical, civil, or other engineering; engineering technology; electronics. Natural resources, forestry, biological science (including zoology), biophysics, geography, interdisciplinary studies including biopsychology, environmental studies, physical sciences including chemistry, and physics.

Technical/professional: Mechanic technology including transportation, protective services, con air/other transportation, precision production; agriculture, agricultural science, architecture, professional city planning, journalism, communications, communications technology, cosmetology, military science, dental/medical technology, home economics, vocational home economics including child care, law, basic/personal skills.

Appendix B: Additional Tables

Table 6: Persistence Rates (Bachelor's Degree Earned), by Race/Ethnicity and Major of 1995 Beginning Postsecondary Students: Spring 2001								
	Total	Education	Humanities	Social/ Behavioral Sciences	STEM	Business	Health	Technical/ Professional Majors
All Students	62.0	65.3	60.8	64.9	64.6	65.5	64.1	57.5
African Americans	45.8	47.4	50.0	56.5	41.8	46.9	57.1	42.1
Asian Americans	72.5	Low n	85.7	58.3	77.4	85.0	85.0	83.3
Hispanics	50.9	31.8	61.5	48.4	48.6	67.3	35.0	40.0
Whites	65.0	70.8	60.6	68.4	69.3	65.5	66.2	61.1

Note: Data are for students who began at four-year institutions, seeking a bachelor's degree or higher.
Source: U.S. Department of Education, Beginning Postsecondary Student Longitudinal Study: 1996/01.

Table 7: Delta-P Statistics of Completing a Bachelor's Degree, by Racial/Ethnic Groups

Variable	Whites	African Americans	Hispanics	Asian Americans
Age	-.18*			
Gender	.07**			
Parental income (reference: high income)				
Low parental income	-.16***			
Middle parental income				
Parental education				
Non-first generation	.09***	.29*		
High school curriculum rigor				
(reference: highly rigorous)				
Not meet new basics	-.37***		-.30*	
Not rigorous	-.23***			-.66*
Slightly rigorous	-.18***			
Moderately rigorous	-.14**			
Dependent (reference: non-dependent)				
Degree aspirations as a freshman				
Delayed enrollment				-.58*
Attendance status (full-time)	.22***	.30*	.29*	
Grant amount (reference: no grant)				
Low amount (less than $2,000)				
Medium amount (less than $5,000)				
High amount (more than $5,000)	.10*	.44***		
Loan amount (reference: no loans)				
Low amount (less than $2,625)				
Medium amount (more than $2,625)				
Work experience (reference: not working)				
Working 14 hours or less a week		.29*		
Working 15 hours or more a week	-.12***		-.22*	
Social integration	.03***			
Academic integration				
Institutional control				
College major (reference: STEM)				
Social science				
Humanities				
Education				
Life science				
Business			.37*	
Health		.34*		
Vocational				
Other majors				
Estimated population means (% students who completed their BAs)	.65	.45	.50	.72
chi-square	360.713***	72.440***	61.260***	44.800*
% of cases properly classified	76%	79%	76%	83%

Note: Only the variables that have statistically significant association with degree completion rates are included in this table.
Note: * .05, ** .01, *** .001

Table 8: Variable Coding Scheme

Variables	Coding scheme
Individual background variables	
Age	
Traditional age (17, 18, and 19 in 1995–96)	0=no, 1=yes
Non-traditional age (older than 19)	0=no, 1=yes
Gender	0=male; 1=female
Parental income percentile (reference: high-income)	
Low-income (lowest one-third)	0=no; 1=low income
Middle-income (middle third)	0=no; 1=middle income
Parental education	
First generation (neither of the parents has a bachelor's degree)	0=no, 1=yes
Non-first generation	0=no, 1=yes
High school academic rigor (reference: highly rigorous)	
Not meet new basics	0=no, 1=yes
Not rigorous	0=no, 1=yes
Slightly rigorous	0=no, 1=yes
Moderately rigorous	0=no, 1=yes
Dependency status	
Independent	0=no, 1=yes
Dependent	0=no, 1=yes
Degree aspiration in 1995–96 at any higher education institutions	0=bachelor's degree; 1=master's degree; 2=advanced degree
Delayed enrollment	0=no; 1=delayed
College experience variables	
Attendance status	0=no; 1=full-time, full-year
Amount of grant received (reference: no grant)	
Low amount (less than $2,000)	0=no; 1=yes
Medium amount (less than $5,000)	0=no; 1=yes
High amount (more than $5,000)	0=no; 1=yes
Loan amount (reference: no loans)	
Low amount (less than $2,625)	0=no; 1=yes
Medium amount (more than $2,625)	0=no; 1=yes
Work experiences (reference: no work)	
14 hours or fewer a week	0=0; 1=yes
15 hours or more a week	0=0; 1=yes
Social integration[1]	0=low thru 4=high integration
Academic integration[2]	0=low thru 4=high integration
College major (reference: STEM)	
Social science	0=0; 1=Social science
Humanities	0=0; 1=Humanities
Education	0=0; 1=Education
Business	0=0; 1=Business
Health	0=0; 1=Health
Technical/professional	0=0; 1=Technical/professional
Other majors	0=0, 1=Other majors
Institutional characteristics	
Institutional control	
Public four-year	0=no; 1=yes
Private, nonprofit four-year	0=no; 1=yes

[1] Social integration is a composite measure of following items: attended fine arts activities, participated in intramural or non-varsity sports, participated in varsity or intercollegiate sports, participated in school clubs, or gone places with friends from school.

[2] Academic integration is a composite measure of following items: participated in study groups, had social contact with faculty, met with an academic advisor, or talked with faculty about academic matters outside of class.

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