Upping the Numbers:

Using Research-Based Decision Making to Increase Diversity in the Quantitative Disciplines

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A Report Commissioned by the GE Foundation

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Table of Contents

Introduction

Countless reports have been issued in recent years by education, business, and government identifying an urgent issue in education and the workforce: the underrepresentation of large segments of the U.S. population in quantitatively-based occupations—and the impact of this imbalance on industry and society.

This report is among the first to gather data on what really works to increase underrepresented students' interest and success in these fields, and to compile specific recommendations based on that data. These are not abstract exhortations, but actions that all of us can take as educators, community practitioners, policymakers, and funders.

We have a unique opportunity at this time in history. We can invest in efforts that simultaneously strengthen the nation's economic competitiveness, address a labor market need and open doors to challenging and rewarding careers. Many of the students who would benefit from these efforts come from families struggling on the edges of our economy. These efforts provide a way for those students to change their trajectories for the future.

GE and the GE Foundation, the company's philanthropic foundation, have been long-time investors in expanding educational opportunity, particularly in quantitative fields like engineering and business. In the early 1970s, then-CEO Reginald Jones was instrumental in the creation of the National Action Council for Minorities in Engineering. The GE Foundation's Faculty for the Future initiative, a $20 million, ten-year initiative, has resulted in over 200 new faculty members in engineering, sciences and business—nearly 5 percent of all underrepresented minorities and women entering the faculty in those fields in the past five years—with hundreds more in the pipeline.

In 2001, based on the principles in this report, the GE Foundation launched a new Math Excellence initiative, which has committed over $12 million to date for K–16 efforts to help more minorities and women prepare for, enter, and succeed in these fields.

Fortunately we are not alone. Many, many others around the country are similarly committed to these goals. We believe the findings of this report can help all of us accelerate our impact. In that spirit we are pleased to present this report and look forward to joining with you to open the doors of opportunity.

GE Foundation

About the GE Foundation

The GE Foundation (www.gefoundation.com), the philanthropic foundation of the General Electric Company, invests in initiatives that improve educational opportunity and strengthen community organizations in GE communities around the world. Last year the GE family contributed $120 million to community and educational institutions.

About Education Development Center, Inc.

EDC (www.edc.org) is a non-profit research and development organization devoted to improving health and education around the world.

About Campbell-Kibler Associates, Inc.

Campbell-Kibler Associates, Inc. (www.campbell-kibler.com) is an educational consulting firm specializing in educational research and evaluation with an emphasis on mathematics and science education and issues of race/ethnicity, gender and disability.

We are pleased to introduce the second printing of "Upping the Numbers: Using Research-Based Decision Making to Increase Diversity in the Quantitative Disciplines." "Upping the Numbers" was written to provide the GE Foundation (then the GE Fund) with research based recommendations to assist them in their development of educational initiatives to increase the quality and diversity of the workforce in quantitatively intense disciplines. Since it was written, "Upping the Numbers" has been broadly cited and used in reform systems far beyond the original scope of our work. We are delighted by the reception it has had in the broader STEM reform community and are pleased that the GE Foundation is supporting this reprinting.

This second printing is not a revised second edition and still reflects the original focus and limiting conditions as originally published. We hope that people will continue to find it useful and that its continued dissemination will encourage a trend toward the development of easy to use, research based reports to facilitate the use of data in educational decision-making at all levels.

Upping the Numbers:

Using Research-Based Decision Making to Increase Diversity in the Quantitative Disciplines[1]

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> Today's U.S. economy depends more than ever on the talents of skilled, high-tech workers. To sustain America's preeminence we must take drastic steps to change the way we develop our workforce. An increasingly large proportion of the workforce consists of women, underrepresented minorities and persons with disabilities—groups not well represented in science, engineering and technology (SET) fields. Unless the SET labor market becomes more representative of the general U.S. workforce, the nation may likely face severe shortages in SET workers, such as those already seen in many computer-related occupations (CAWMSET, 2000).

This statement, by the members of the Congressional Commission on the Advancement of Women and Minorities in Science, Engineering, and Technology Development (CAWMSET) in their letter to the president, Congress, and the National Governors Association, sums up the problem: If majority women and minority women and men were getting degrees in the quantitative disciplines, including math, economics, engineering, and computer and physical sciences, at the same rate as their representation in the general population, there would now be more than a million more workers in these fields.[2] And they will be needed. Computer engineer, computer support specialist, and systems analyst are the three fastest-growing occupations in the United States (BLS, 1999).

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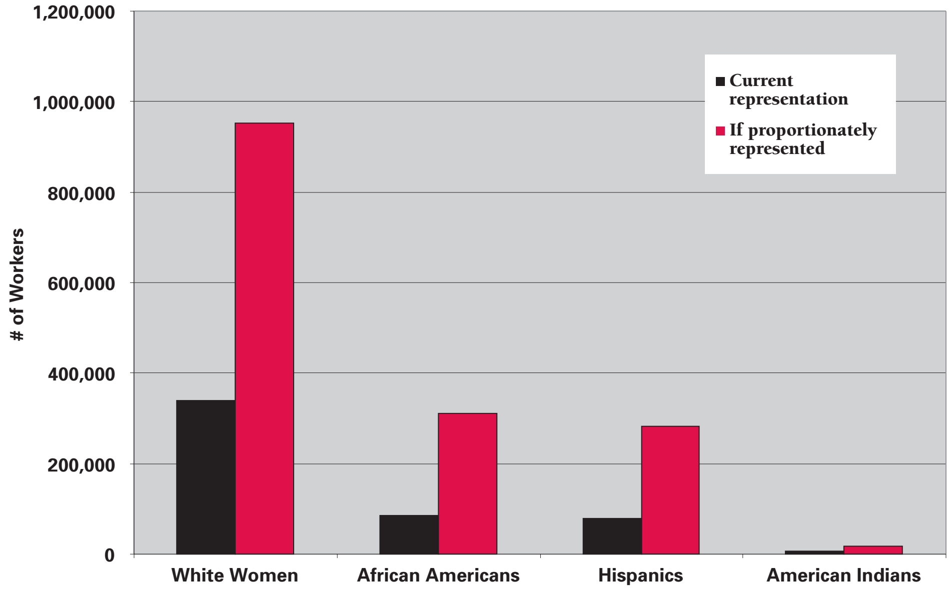
[1] A report commissioned by the GE Foundation. Thanks go to Dr. Suzanne Brainard, Dr. Beatriz Chu Clewell, Mr. Tom Kibler, and Mr. Roger Nozaki for their helpful reviews of the draft report.

[2] Supporting research, tables, and charts for this and all other aspects of the paper can be found on EDC's website www.edc.org.

Minorities are projected to make up more than 40 percent of new workforce entrants by the year 2008 (BLS, 1999). However, without major changes, they will continue to be dramatically underrepresented in quantitative fields. African Americans comprise less than 5 percent of the workers in mathematical and computer sciences and under 4 percent of the engineering, physical sciences, and economics workforce. Hispanics make up less than 4 percent of the quantitative disciplines workforce, and Native Americans, less than half of 1 percent (NSF, 2000).

If Participation in Quantitative Fields Reflected the Population



Increasing the numbers of majority women and minority women and men in quantitative disciplines will require an understanding of where and why different groups leave the pipeline and what opportunities exist as the leverage points for change. The following provides an overview of these issues at the pre-college and college levels, including recommendations for future directions in program development.

Pre-College

In this overview of the status of pre-college education in quantitative disciplines among women and minorities, we focus on three aspects that are key to student advancement: achievement, course-taking and interest. For each of the areas, data are available to allow us to compare and track changes across the fourth, eighth, and twelfth grade levels.

Students at Fourth Grade

Achievement

Nationally, the mathematics achievement of nine year olds, as measured by the National Assessment of Educational Progress (NAEP), has been increasing for the past 25 years. Unlike earlier years when girls had higher average NAEP scores than boys, boys' scores are now slightly higher than girls' (about 1 percent).[3] NAEP score differences between majority and minority nine year olds have not changed much through the years, with African American and Hispanic students still scoring about 12 percent below whites. Twenty-eight percent of white students are doing well in mathematics, scoring at or above the level defined by NAEP as proficient, compared to 5 percent of African American and 8 percent of Hispanic and American Indian students (Campbell, Hombo, and Mazzeo, 2000; NSF, 1999).

Course-Taking

Across the elementary grades, within schools, students follow similar curricula, and course-taking is similar for boys and girls, and minority and majority students. However, the quality of the courses taken may vary between minority and majority students. In schools with higher percentages of minority students, there is a concomitant increase in the percentage of teachers who have emergency/waiver, provisional, probationary, or temporary teaching certifications (NCES, 2000).

Interest

Students as young as nine see physical science- and technology-related courses as appropriate subjects for boys to study. Life sciences were seen as appropriate subjects for girls to study (Farenga and Joyce, 1999).

Students at Eighth Grade

Achievement

Within the United States, the pattern for 13 year olds is similar to that of nine year olds. Mathematics achievement, as measured by NAEP, has been increasing through the years, and the average differences favoring girls have shifted to slightly favoring boys (1 percent). Differences between majority and minority students have decreased minimally, with African Americans scoring 11 percent and Hispanics scoring 8 percent lower than whites. Thirty-one percent of white students are doing well in mathematics, scoring at or above the NAEP-proficient level, compared to 4 percent of African American students, 9 percent of Hispanic students, and 13 percent of American Indian students (NSF, 1999). On international tests, U.S. students do better in mathematics and science at the fourth grade level than they do at the eighth grade level (Campbell, Hombo, and Mazzeo, 2000).

Course-Taking

More students are now taking Algebra in the eighth grade than have previously (Campbell, Hombo, and Mazzeo, 2000). Girls, white students, and Asian American students are dispro-

[3] Percentages were computed by dividing the difference in scores by the groups by the score of the higher scoring group (i.e., male score-female score/male score)

portionately more apt to take Algebra in eighth grade, giving them the potential to take Calculus in high school (Gamoran and Hannigan, 2000).

Interest

By eighth grade, independent of racial/ethnic group, twice as many boys as girls are interested in quantitative disciplines and science careers. Girls have been found to have less interest in math than boys and less confidence in their mathematics abilities, even though they don't lag behind boys in grades or test scores. Hispanic and African American eighth graders have more positive attitudes about mathematics and are more apt to be involved in math/computer clubs than white students, but their interest in these careers is less than that of white students (Catsambis, 1994).

Students at Twelfth Grade

Achievement

NAEP mathematics achievement scores for 17 year olds have been increasing over time, with boys scoring minimally higher than girls (less than 1 percent). NAEP achievement score gaps between Hispanic and white students have remained fairly constant at about a 7 percent difference, while gaps between African American and white students have increased to 10 percent. Translated into proficiency levels, these disparities appear even more striking. At present, 20 percent of white and 33 percent of Asian American students score at or above NAEP proficiency levels, compared to 4 percent of African American students, 6 percent of Hispanic students, and 3 percent of American Indian students. The percentage of African American, Hispanic, and American Indian students scoring at NAEP's advanced level is 0 (Campbell, Hombo, and Mazzeo, 2000; NSF, 1999)! [4]

Course-Taking

Currently, nearly two-thirds of 17 year olds report taking Algebra II or Precalculus and/or Calculus, with girls and boys taking advanced mathematics courses at about the same levels (Campbell, Hombo, and Mazzeo, 2000; NSF, 1999). The pattern is different for minority students; white students are almost twice as apt to take Precalculus and/or Calculus than Hispanic students and almost four times as likely to do so than African American students (Campbell, Hombo, and Mazzeo, 2000).

Interest

Among SAT takers, only 6 percent of the students want to major in computer or information science, and less than a quarter of those are girls. Girls are less than one-tenth of the students (8 percent) who want to major in engineering. Almost no one wants to major in mathematics (1 percent), although about half of that small number are girls (College Board, 2000).

[4] Individual minority students do score at superior levels of math proficiency, however, the overall percentage of students scoring at advanced levels is less than 0.5 percent and thus rounds down to 0 percent for reporting purposes.

Behind the Numbers: Research-Based Implications for Change

Girls graduate from high school with skills and knowledge comparable to boys, but few girls continue in quantitative fields. Relatively few African American, Hispanic, and American Indian students graduate from high school with the skills and knowledge necessary to continue in quantitative fields.

As the above indicates, while there is overlap, many of the issues related to careers in the quantitative disciplines differ for young majority women and for young minority women and men. When young women graduate from high school, they have math, engineering, and technology skills and knowledge in numbers and percentages comparable to young men, although some gaps exist at the most advanced levels. But young women are much less apt than young men to continue in quantitative disciplines, regardless of their preparation.

In contrast, even though the math achievement and course-taking of minority students has been increasing, relatively few African American, Hispanic, and American Indian students graduate from high school with the skills and knowledge they need to continue in quantitative disciplines. Even fewer go on in these areas (Campbell and Hoey, 1999).

With intensive curricula and high expectations, students of all backgrounds learn; however, at eighth, tenth, and twelfth grades, consistently fewer underrepresented minority students report being placed in high-ability, college preparation, and advanced placement programs (Huang, Taddese, and Walter, 2000). Urban high schools serving predominantly poor minority students typically offer far fewer AP courses—especially mathematics and science AP courses—than do suburban high schools of comparable size (Oakes, Muir, and Joseph, 2000). Many urban schools do not even offer math beyond Algebra II (Oakes, Muir, and Joseph, 2000).

Yet having a high school curriculum of high academic intensity and quality is the strongest pre-college predictor of college completion, especially for African American and Hispanic students (Adelman, 1999). And, not surprisingly, students who take more advanced mathematics courses in high school have higher achievement test scores and higher SAT math scores (Campbell, Hombo, and Mazzeo, 2000; College Board, 2000).

Some things can make a difference:

A Strong Core Curriculum

- ❧ A high school core curriculum approach, where almost all students take the same, mostly academic, courses, was associated with higher achievement for students, independent of race/ethnicity, gender, or income level (Lee, Burkham, Chow-Hoy, Smerdon, and Geverdt, 1998).
- ❧ A rigorous core of academic courses was a common characteristic distinguishing high-performing schools from middle- and low-performing schools (Bradley and Teitelbaum, 1998).

Hands-on Learning

- ❧ NAEP science achievement scores were higher for 9 year olds who used equipment like meter sticks, scales, and compasses in class (Campbell, Hombo, and Mazzeo, 2000).

- Students who did in-class hands-on learning activities out-performed other eighth grade students on the NAEP mathematics test (Wenglinsky, 2000).
- Doing physical science laboratory activities improved girls' achievement, while not affecting boys' achievement (Burkham, Lee, and Smerdon, 1997).
- Using a hands-on outdoor-based science curriculum reduced achievement differences between white and American Indian students (Zwick and Miller, 1996).
- NAEP mathematics achievement scores were higher for 17 year olds who had access to computers to learn mathematics and solve mathematical problems (Campbell, Hombo, and Mazzeo, 2000).

Knowledgeable Teachers

- At the eighth grade level, having a teacher with a major or minor in mathematics was related to higher student mathematics achievement scores on the NAEP (Wenglinsky, 2000).
- Students of teachers who received professional development in higher-order thinking skills for mathematics had higher NAEP mathematics achievement scores (Wenglinsky, 2000).

Effective Programming

- Programs for pre-college girls that combine hands-on activities and the provision of role models through mentoring, internships, and career field trips tended to lead to girls' increased self-confidence and interest in math, engineering, science, and technology courses and careers, as well as fewer sexist attitudes about these fields (Campbell and Steinbrueck, 1996; Clewell and Darke, 2000; Expanding Your Horizons, 1999). Unfortunately, because of the lack of longitudinal studies, little is known about the impact of these strategies on girls' continuation in quantitative and science courses, majors, jobs, and careers.
- Programs for minority students that have a demonstrated impact on the continuation of these students in quantitative disciplines and science have a variety of common components, including the following:[5]
    - Working with teachers and parents as well as students
    - Raising teachers' expectations for students
    - Providing students with more rigorous courses and academic support
    - Offering resources to help students get into college, such as SAT preparation, college trips, information on financial aid resources, and financial support for taking the fee-based exams (Campbell and Hoey, 1999)

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[5] The programs include: MESA (Mathematics, Engineering, Science Achievement) (http://www.coe.berkeley.edu/cues/html-Mesa.html), SECME (Southeastern Consortium for Minorities in Engineering) (http://www.che.ufl.edu/index.html), Equity 2000 (http://www.collegeboard.org/index.html) and the Gateway to Higher Education in New York City (Campbell et al, 1998.)

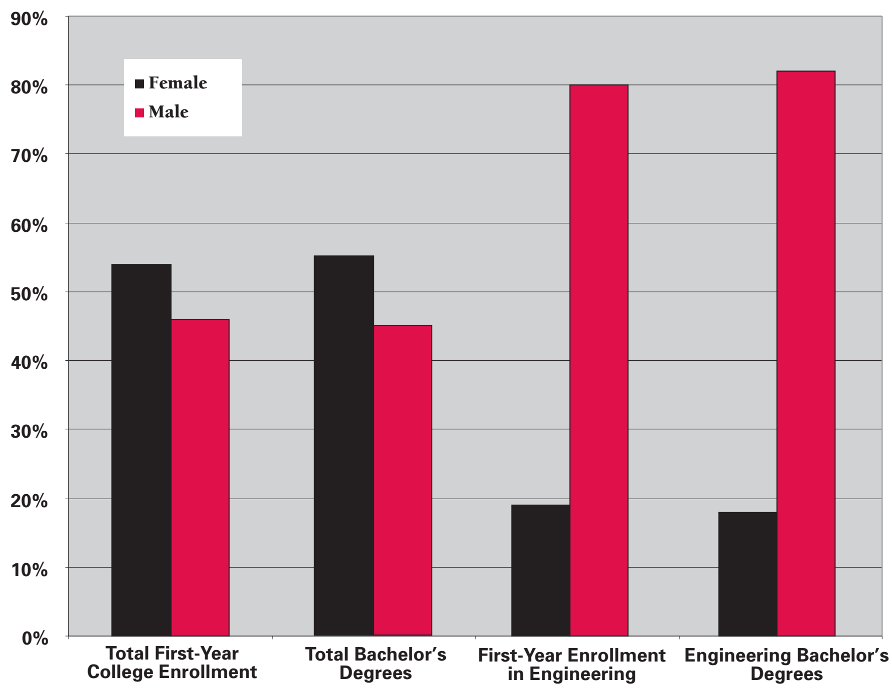
College and Beyond

College

For the past 15 years, although college enrollments have gone up, the number of bachelor's degrees conferred in quantitative disciplines has been declining (NSB, 2000; NSF, 2000). In computer science, the number of bachelor's degrees awarded has declined for both women and men, from a total of 32,435 in 1984 to 24,545 in 1996. At the same time, the proportion of computer science degrees awarded to women decreased from a high of 37 percent in 1984 to 28 percent in 1996 (NSF, 2000).

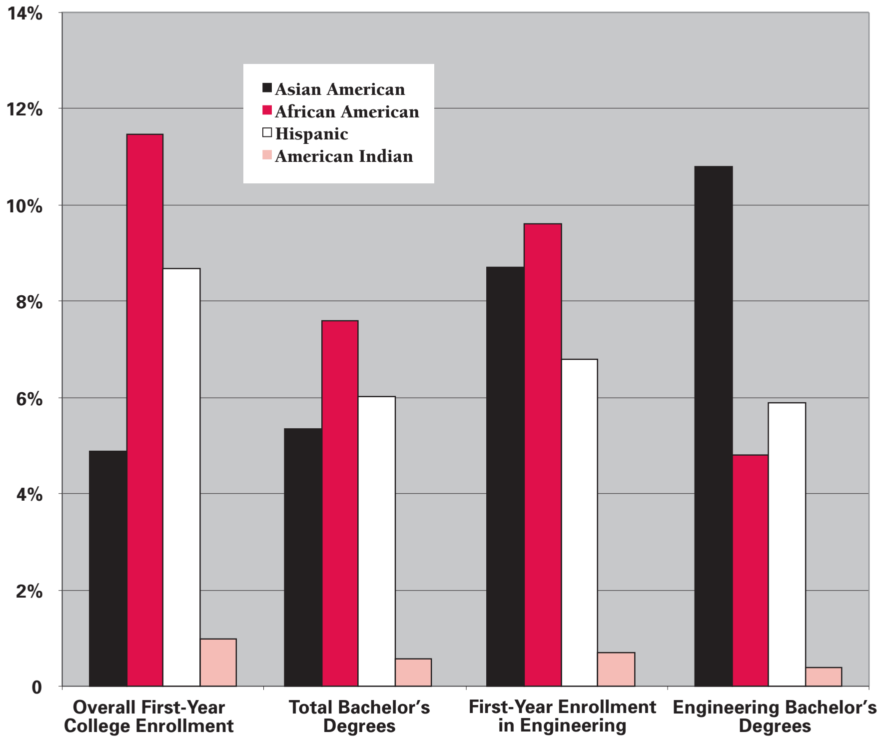
As the following graph indicates, women are more apt to go to college and graduate than are men; however, women of all racial/ethnic groups are less likely than men to choose to study engineering and science (Astin, Korn, Sax, and Mahoney, 1994). Men are more than four times more likely than women to go into engineering (NSF, 2000). However, while women are much less likely to be in engineering, they appear to be graduating in approximately the same percentages in which they enrolled (Huang, Taddese, and Walter, 2000; NSB, 2000; NSF, 2000).

Sex Differences in Overall College Recruitment and Retention Compared to that of Engineering



As shown in the next graph, the results are quite different for minority students:

Racial/Ethnic Differences in Overall College Recruitment and Retention Compared to that of Engineering



The racial/ethnic enrollment gap in engineering is not as large as the gender gap where women are more than 50 percent of those enrolled in college and less than 20 percent of those enrolled in engineering. African Americans make up almost 12 percent of college freshman and almost 10 percent of engineering freshman. However, African American, Hispanic, and American Indian students face greater difficulties in engineering and science programs and seem to have greater difficulty than Asian Americans (or whites) in attaining bachelor's degrees in engineering and science, as well as all other fields (Huang, Taddese, and Walter, 2000; NSB, 2000; NSF, 2000).

Graduate School

Overall, graduate school enrollment has been increasing, but graduate enrollment in quantitative disciplines has been decreasing since 1992. While female enrollment has risen to 55 percent of all graduate students, only 27 percent of the 36,010 computer science majors and 18 percent of the 101,008 engineering majors are women. This same pattern is reflected in degree-granting; in the late '90s, women earned 27 percent of the 10,223 master's degrees and 19 percent of 889 doctorates conferred in computer science. In engineering, they earned 17 percent of the 27,757 master's degrees and 16 percent of the 6,052 doctorates (NCES, 1999; NSF, 2000). Lewis' 1991 quote appears to be equally true today:

> While it is difficult to obtain hard data, there is strong evidence that women constitute only about 30 percent of those pursuing a curriculum that leads directly to a doctoral program. Thus, the fact that women constitute about 25 percent of U.S. citizens earning a mathematics doctorate would indicate we are losing many well-qualified women at the doctoral level and that to increase the number of women doctorates requires getting them into appropriate undergraduate programs (Lewis, 1991).

At the same time, African American and Hispanic graduate enrollment in quantitative disciplines has risen slightly but remains at between 2–4 percent, far below their 11–12 percent representation in the general population. The percentages are similar for degrees, yet the numbers speak volumes. For example, only 379 African Americans received computer science master's degrees (3.7 percent of the total), 674 received engineering master's degrees (2.4 percent of the total), and 4 received doctorates in the computer sciences. The pattern was similar for Hispanic students, who received 1.8 percent (188) of the computer science master's degrees, 2.7 percent (748) of the engineering master's degrees, and 3.2 percent (16) of the computer science doctorates. For American Indians, the numbers are even lower; in 1997, only one American Indian received a doctorate in computer science (NSF, 2000).

Behind the Numbers: Research-Based Implications for Change

Though African American, Hispanic, and American Indian students who go on to college major in quantitative fields at about the same percentages as whites, they are much less apt to graduate. Women go into quantitative majors in much smaller numbers than men, but once there, they are equally apt to graduate.

A strong high school background, particularly in math, is key to overall success in college. Of all the pre-college subjects, the highest level of mathematics studied in secondary school has the strongest continuing influence on bachelor's degree completion. Finishing a course beyond the level of Algebra II, such as Trigonometry or Precalculus, more than doubles the odds that a student who enters postsecondary education will complete a bachelor's degree (Adelman, 1999).

However, relatively low self-confidence in mathematics-related subjects strongly predicts a non-science and non-engineering major, while declining confidence during the early years of college often leads to a switch from science and engineering to other fields (Sax, 1995; Seymour and Hewitt, 1997; Ware and Lee, 1988).

Even though their retention rates are low, Historically Black Colleges and Universities (HBCUs) graduate the largest numbers of African American scientists. The five institutions graduating the highest numbers of African American engineers and scientists, both women and men, are all HBCUs (NSF, 2000).

The field of "geodemographics" has allowed institutions to create models that optimize the rate of student yield per recruitment dollar invested. These retrospective models mine data for past success. The resulting predictor variables inevitably point college recruiters toward communities with a higher density of parental degrees and communities with lower student need per admission (College Board, 1999). These variables are significantly less likely to target underrepresented minorities (Nettles and Perna, 1997).

Some things can make a difference:

A Rigorous High School Curriculum

- Freshman undergraduates from low-income families, from higher-poverty schools with parents who had not attended college, were as likely as students from more privileged backgrounds to remain enrolled in four-year colleges and universities if they had completed an intensive mathematics and science curriculum in high school (NCES, 2000).

Small-Group Learning

- College student participation in small-group learning in math, engineering, and technology increased academic achievement, attitudes toward learning, and persistence. Women and men had similar gains in achievement independent of whether the groups were single- or mixed-sex. However, African American and Hispanic students' achievement gains were higher when they participated in small groups composed primarily of members of their ethnic groups (Springer, Stanne, and Donovan, 1999).

Programs for Students as a Group

- There is some indication that enrichment programs run by engineering and science departments with field-related material offered to *all* students work better for underrepresented minorities and women because such programs are not subject to stigmatization (Bonsangue and Drew, 1995; Seymour and Hewitt, 1997).

College and Career Orientation

- Participating in extended orientation programs, including intensive pre-enrollment on-campus experiences and continuing first-year advising programs, increased retention for all students. The impact was even stronger for African American and Hispanic students (Erickson and Strommer, 1991; Strommer, 1992).

Research Experience

- The National Science Foundation's program, Research Experiences for Undergraduates (REU), was successful in encouraging students to pursue mathematics, engineering, technology, and science careers, with REU participants being more likely than non-REU undergraduates to continue to graduate school in quantitative disciplines and science (Lewis, 1991).

Internships

- An extensive internship/work experience program with a 35 percent minority participation rate was found to yield an employee pool that was more than 50 percent minority (SHRM, 2000). A similar program focusing on students with disabilities had an equally high employment rate (Stern, 2000).

Recommendations

If systems don't change, then the deficits in those systems will continue, and programs to remedy those deficiencies will need to be ongoing.

Currently, much of our effort to increase the number of underrepresented students in quantitative disciplines goes toward implementing and/or continuing special programming for a relatively small number of students and teachers. While there is value in this effort, it is basically remedial. These types of projects work with individual students or teachers to remedy deficits in existing educational, youth development, and even societal systems, but they do not work to change systems. The recommendations that follow are intended to target leverage points where an intervention has the potential to make longer-term change.

At the Elementary School Level

Currently, there is some controversy about ways to teach mathematics at the elementary school level. Nationally, groups such as the National Research Council and the National Science Foundation focus on the importance of conceptual understanding, while states such as California and Massachusetts have moved back to a more skills-based approach. Some curricula selected by the U.S. Department of Education as "exemplary" or "promising" are not approved for use in some states. At this point, there is not a great deal of research that ties specific programs and strategies to later participation in quantitative careers.

While there is much that states, districts, and the federal government can do at the elementary school level, it is less clear what corporations and other private funders can do, and there are no specific recommendations for their action at the elementary school level at this time.

At the Middle School and High School Levels

At the middle and high school levels, it is recommended that corporations and other interested funders focus on promoting school reform efforts that have been found to increase achievement and participation in quantitative disciplines. There are five specific recommendations:

I. Provide resources for continuing and institutionalizing programs that combine hands-on activities and the provision of role models through mentoring, internships, and career field trips.

II. Make more advanced math, economics, and physical science courses available.

- Provide schools with information and equipment to review, evaluate, and access distance-learning courses, either through satellite broadcasts or the Web.
- Use corporate employees with expertise in the quantitative disciplines to train interested local high school teachers in the content areas needed to teach the more advanced subjects, and have interested teachers take College Board/ETS Advanced Placement (AP) training.

- Set up high school/college collaboratives where high school students are encouraged to take courses not offered by their high schools at local colleges, tuition-free.

III. Provide students with more hands-on/laboratory experiences in required quantitative and physical science courses.

- Provide schools with needed equipment.
- Provide teachers with training to use the equipment.

IV. Make existing courses of higher quality.

- Work with schools to implement a process of conducting content and pedagogical reviews of math and technology courses.
- Set up collaborations with local colleges to have teachers take courses, as needed.
- Have corporate employees with expertise in the quantitative disciplines provide teachers with needed skills.
- Provide teachers with needed materials, such as graphing calculators, software, and modems, and instruction in how to use them in specific quantitative courses.

V. Make it possible for more students to take advanced courses.

- Within schools, institutionalize ways to provide students and parents with user-friendly information about course requirements for different jobs, college requirements, colleges, and paying for college.
- Work with counselors and teachers to implement strategies to recruit more students into math and technology courses and to schedule advanced math, technology, and physical science courses at times that don't conflict with popular electives.
- Endow a fund to pay the AP exam fees in quantitative areas for students in need and, where appropriate, to pay the PSAT and SAT achievement test fees for students in need who are interested in quantitative fields.

At the College Level

It is recommended that corporate and other private funders work to strengthen and expand efforts to recruit and support students in five specific ways:

I. Focus efforts to increase the numbers of women in these fields at the recruitment stage.

- Increase the visibility of women with careers in the quantitative disciplines to college-bound women.
- Support school visitation programs that use diverse role models.
- Provide students with clear information on career pathways.

II. Support the institutionalization of programs in the quantitative disciplines that are available to all and that serve the needs of minority students.

- Have volunteers staff on-line tutorials and "help sessions" that are focused on foundational skills specific to introductory coursework in quantitative areas.
- Work with universities to implement and/or expand support programs in quantitative disciplines, and support research on the content and pedagogy of the most effective programs.
- Support programs that involve first-year students in undergraduate research experiences.

III. Target Historically Black Colleges and Universities (HBCUs).

- Support the development and institutionalization of retention programs.
- Support summer research opportunities and faculty development programs for HBCUs.

IV. Support undergraduate research programs in universities and internship programs in industry that promote meaningful research experiences for students of all backgrounds.

V. Support the development of yield management tools and recruitment strategies that successfully reach minority high school students.

- Support a consortium of schools that, together with econometric and mathematical modelers, will develop and refine yield management programs that are sensitive to identifying prospects in traditionally low-yield environments.

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