

A National Study of Science, Technology, Engineering, and Math Education at Hispanic-Serving Institutions

Preliminary Report of the Task Force

Introduction

The Hispanic Association of Colleges and Universities (HACU), by utilizing its unique capability and position, will conduct a national study of the state of Science, Technology, Engineering, and Math (STEM) Education at Hispanic-Serving Institutions (HSIs); and of the factors that enhance HSIs' capabilities to produce the number of Hispanic STEM graduates and graduate students needed to broaden and develop the next generation of the STEM workforce so necessary to the nation's economic security.

The goals of this study are: 1. Assess the major barriers to Hispanic undergraduate and graduate students successfully completing STEM degrees. 2. Assess the status of U.S. Hispanic STEM faculty at HSIs. 3. Assess STEM research and technology infrastructure at HSIs. 4. Assess STEM research, education, and training programs designed to attract, train, and retain Hispanic students and faculty. 5. Strengthen the NSF-HACU-HSI partnership.

The outcomes of the study will: 1. Provide baseline data on STEM education at HSIs for Hispanic students and faculty. 2. Identify infrastructure, faculty, and student preparation needs at HSIs. 3. Create of an initial network of NSF-experienced Hispanic faculty and administrators. 4. Develop of a database of research and training programs for Hispanic students and faculty to be shared with HSIs, Hispanic students and faculty. 5. Strategies and recommendations to guide the NSF, HACU, and HSIs in developing the infrastructure necessary to fulfill the potential of Hispanic students, faculty, and HSIs in the fields of STEM education and research.

In order to produce useful short-term and long-term recommendations to strengthen the HACU-NSF-HSI partnership, a Task Force was formed to: 1. Provide input on the scope, framework, and methodology of the study; 2. Review and evaluate the results of the study as it progresses; 3. Analyze the data gathered; and 4. Assist in formulating recommendations based on the results. This Task Force includes STEM faculty and researchers familiar with the NSF culture from a range of HACU institutions. This is the Task Force's preliminary report.

Background:

The intellectual merit of this national study resides in its importance in advancing knowledge and understanding of the state of STEM education at Hispanic-Serving Institutions. **HSIs enroll almost one-half (49%) of all Hispanic students even though HSIs account for just five percent of all institutions of higher education.** Given the almost 60% increase in the Hispanic population from 1990 to 2000 and given projected

demographic growth, Hispanic enrollment will continue to grow at these institutions. Hispanics however receive only a small percentage of Ph.D.s in science and engineering (4% in 1997). For many Hispanic students, HSIs are the only realistic postsecondary education opportunity because of the proximity to home and the reasonable costs. When Hispanics attend institutions of higher education as undergraduates, they are more likely to earn bachelor's degrees from colleges and universities in regions of the country where they are concentrated. **Yet the communities in which many HSIs are located are some of the most underserved communities in this country. Unless Hispanic Americans and our nation reverse the stubbornly persistent trends of educational underachievement and under-representation of Hispanics in higher education, America's STEM workforce is at high risk. HACU and its member HSIs are in an advantageous position to address that national need by effectively broadening the STEM-trained workforce.**

Need

The 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), states the problem and points the path to resolution plainly, "As we enter the twenty-first century, U.S. jobs are growing most rapidly in areas that require knowledge and skills stemming from a strong grasp of science, engineering, and technology... (however) business leaders are warning of a critical shortage in skilled American workers that is threatening their ability to compete in the global marketplace. **Yet, if women, underrepresented minorities, and persons with disabilities were represented in the U.S. science, engineering, and technology (SET) workforce in parity with their percentages in the total workforce population, this shortage could largely be ameliorated.**" The same report states that while in 1997 Hispanics made up 9.9 percent of the total population and 9.2 percent of the total U.S. workforce, they made up only 3.0 percent of the SET Workforce. The National Science Foundation's *Science and Engineering Indicators 2002* substantiates the shortage specifically in higher education, and states that compared to many other industrialized countries, the U.S. awards fewer natural science and engineering bachelor's degrees relative to the size of the college-age population. With regard to science and engineering (S&E) doctorates, most of the growth in the number of S&E doctorates awarded in the U.S. in the past two decades reflects a substantial increase in doctorates earned by non-U.S. citizens. An increasing proportion of doctoral scientists and engineers employed in academia are foreign born (data from same report). The NSF report, "*Women, Minorities, and Persons with Disabilities in Science and Engineering 2000*", states, "... as in the 1982 report (1982 version of the "*Women....Engineering* report), black and Hispanic faculty were less likely than white faculty to be full professors, even after adjusting for differences in age. The data from the NSF's *Science and Engineering Indicators 2002* also point to the low numbers of Hispanic faculty, especially at the higher academic ranks.

Hispanic Americans will be a key element in the economic and social development of the United States in the coming decades. The increase in the Hispanic population has brought about significant changes in the United States, including changes in regional

population and demographic patterns, changes in local regional and national politics, and the development of an economic market force estimated to be 425 million dollars annually. There has been an almost 60 percent (57.9%) increase in the total Hispanic population between 1990 and 2000, making Hispanics the largest and fastest growing minority group at 12.5% of the population (U.S. Bureau of the Census). The Bureau of Labor Statistics data shows that by the year 2025 approximately one-half of the persons entering the workforce will be Hispanic. Given the scientific and technology foundation of the 21st century economy, the education of Hispanics is absolutely essential.

Coinciding with that growth, there has been an increase in the number of Hispanics attending college. However, the percentage of Hispanics who attended college has only increased slightly as compared to non-Hispanic whites and African Americans. The gap in the college enrollment rates for 18 to 24 year olds between Hispanics and non-Hispanic whites increased from 9 percentage points in 1980 to 19 points in 1998 (*Digest of Education Statistics*: Department of Education, 1998). Although Hispanics place a high cultural value on education, most Hispanic students face geographic and cultural barriers and also have below average incomes—all factors that inhibit their opportunities for higher education. (*The Increasing Presence of Hispanics and Hispanic-Serving Institutions*-HACU, August 2000)

During the 1990's, few Hispanic-Serving Institutions (HSIs), i.e., colleges or universities with a Hispanic student enrollment of at least 25 percent, could be counted among the better-funded institutions of higher education. As the largest, youngest, and fastest-growing ethnic population, Hispanics will be the backbone of the nation's future economic and social well being, and consequently the nation itself will be at risk if Hispanics do not have access to a quality education, especially a first-rate higher education.

When Hispanics attend institutions of higher education as undergraduates, they are more likely to earn bachelor's degrees from colleges and universities in regions of the country where they are concentrated: California, Texas, and Puerto Rico. For example, Puerto Rico awarded 21 percent of the science and engineering bachelor's degrees received by Hispanics in 1990 and 15 percent in 1996. Of the types of institutions they attend, the NSF report, "*Women, Minorities, and Persons with Disabilities in Science and Engineering 2000*", states that black and Hispanic undergraduates have the lowest percentages enrolled in Research I institutions and that American Indian and Hispanic undergraduates are the most likely of the racial/ethnic groups to enroll in two-year institutions

The geographic concentration of Hispanic graduate students in science and engineering is similar to that of undergraduates with Puerto Rico, California, Texas, and Florida institutions enrolling the largest numbers of Hispanic graduate students. Among the top 50 institutions enrolling Hispanic graduate students in science and engineering in 1997, 16 were designated as HSIs. Hispanics as a whole were awarded only 4 percent of the overall total of science and engineering Ph.D.s awarded in 1997 ("*Women, Minorities...Engineering 2000*") (even though Hispanics account for almost 17% of the 20-34 year old population in the U.S). The American Council of Education's report, *Minorities in Higher Education 2000-2001 Eighteenth Annual Status Report* also points out that a significant number of the doctorates awarded in the sciences

from 1989 to 1998 were awarded to non-U.S. citizen Hispanics, and consequently not addressing the critical need to develop Hispanic Americans.

Almost one-third (31%) of those 648,000 (Hispanics enrolled at HSIs) students attend schools in California, with Texas and Puerto Rico HSIs enrolling about 20 percent each (HACU Analysis of Fall 1997 IPEDS). Of 209 institutions identified as HSIs in 1997 by HACU, 107 are two-year institutions, 93 of which are public. Sixty-one of the 102 four-year HSIs are private institutions while 41 are public. Given projected demographic changes, Hispanic enrollment at these schools will continue to grow. As the number of Hispanics entering college increased so did the number of HSIs—between 1990 and 1997 the number of HSIs increased 82% from 115 to 209. A cursory review of current data indicates there are now 249 HSIs. Given the projected increase of college-age Hispanics, the number of HSIs is expected to continue to increase even if the current proportionally low rate of Hispanic college attendance persists, let alone if this disparity is corrected.

A critical issue for HSIs is the lack of resources. The financial resources available to HSIs are generally about one-half those of other institutions of higher education. HSIs report about \$7,255 in annual revenues per student, compared to \$14,328 per student non-HSIs have at their disposal. The disparity is even greater when comparing endowment revenues. HSIs average \$40 per student in endowment revenues, while non-HSIs have \$331 per student (*Hispanic Voter Registration and Hispanic-Serving Institutions: Emerging Trends*, HACU, November 2000)

Obviously, STEM education of Hispanics is currently failing to keep pace with the increase in the potential pool of Hispanic undergraduate and graduate students and failing to produce enough Hispanic Ph.D.s. It is also clear that HSIs are and will continue to play a pivotal role in the science and engineering education of Hispanics. There is a need to study the science education and training needs of HSIs; including infrastructure capacity, pre-collegiate preparation, undergraduate education, graduate education, post-doctoral and other faculty research and training opportunities, and two-year-to-four-year institution articulation, collaboration and transition. Innovative ideas and new models are needed to address the lack of Ph.D. production and build on the opportunities presented by the growing numbers of Hispanic students and of HSIs. **HACU and its 182 member HSI institutions in 11 states and Puerto Rico constitute the natural network of institutions from which to develop a national study of STEM education at HSIs and their communities.**

Identified Barriers to Latinos in STEM Programs:

Undergraduate Barriers

- ❖ K-12 Academic Preparation
- ❖ Lack of Parental Awareness & Involvement
- ❖ High Dropout Rate at Middle School & High School
- ❖ Teacher Training & Preparation
- ❖ Lack of Adequate Career/Academic Advising in K-12
- ❖ Lack of Adequately trained faculty advisors
- ❖ Lack of Information on Financial Aid
- ❖ Lack of Research Infrastructure & opportunities for undergraduate students

Graduate Barriers:

- ❖ Poor academic preparation in the sciences
- ❖ Lack of Career Awareness
- ❖ Lack of Financial Aid
- ❖ Lack of Research Infrastructure & Opportunities
- ❖ Lack of Information & Science Technology Infrastructure
- ❖ Lack of Hispanic/Latino role models/mentors
- ❖ Cultural Barriers

(Specific Barriers for Grad & Undergrad are attached.)

RESEARCH AND TECHNOLOGY INFORMATION INFRASTRUCTURE

The issues and concerns identified by the Task Force could be grouped under the following general categories:

- ❖ Resources/Funds
- ❖ Support/Release Time for Faculty
- ❖ Planning
- ❖ HSI-Corporate Partnerships

Task Force Recommendations: In Priority Order

The Task Force discussed and recommended a strategic goal to guide HSIs, AMIs, and other Institutions of Higher Education (IHEs) in increasing Hispanic participation in the STEM workforce.

Strategic Goal: Increase Hispanic participation in the STEM workforce by increasing graduation rates at all levels in the STEM disciplines by 10% per year for the next decade.

The Task Force discussed and drafted strategies that could be incorporated in action plans by HSIs, AMIs, and IHEs

Action Plan Strategies for HSIs:

- 1. Increase enrollment at the Institutions**
 - Create/Improve Graduate school orientation (focus e.g., on application, GRE, stipends, financial aid, how to secure references etc.)
 - Create/Support Summer Bridge programs
 - Advertise/Market Scholarship opportunities more effectively
 - Develop/ Support Parents' workshops on career opportunities/graduate school
 - Increase Marketing in the Hispanic community

- 2. Increase retention and graduation rates at the Institutions**
 - Create and offer Scholarships

- Develop and fund Internships/Co-op Programs
- Create, fund and support REUs (Research Experience for Undergraduates)
- Encourage use of Study groups
- Provide Student Support training for faculty/staff
- Increase effectiveness of Student Support services
- Fund training for faculty supporting students
- Fund and support Student/professional organizations
- Develop and sponsor annual a Community STEM conference
- Fund faculty and students to attend STEM Conferences
- Provide support and training for STEM Pre-service teachers
- Fund/Support HSI/AMI STEM Faculty to provide
 - o supplementary instruction
 - o tools
 - o resources

3. Increase graduate school enrollment and graduation rates; Provide the following:

- Fellowships - internships
- Research Assistant support – speaker series
- Mentoring
- Travel
- Teaching experiences
- Support services
- Faculty training
- Student/professional organizations
- Community STEM conference
- STEM Conferences travel funds

4. Reduce drop-out rates and improve high school graduation rates

- Create/increase summer enrichment programs
- Create/replicate Saturday academic programs for students
- Conduct Community outreach on middle school and high school STEM curricula
- Create/ Support STEM parents association
- Sponsor Research Experiences for school Teachers
- Provide College/university orientation and workshops (e.g., workshops on SAT, Fin Aid)
- Develop and support High School to College articulation and communication on expectations of student preparation

A K-20 Partnership Model: HACU-NSF STEM Center of Excellence

As a result of discussion of the strategic goal and action plan strategies the Task Force developed consensus on a fundamental approach for increasing opportunities for Hispanics in STEM: Only an integrated effort that involves K-20 partnerships and collaboration will make a significant impact in improving the numbers of Hispanic students successfully pursuing STEM careers. A model that integrates the K-20 approach was proposed: “HACU Centers for STEM Excellence.”

The HACU Centers of STEM Excellence model:

➤ *would have the following Required Partners:*

- K-12 School District (at minimum of one) that is a Hispanic-Serving School District
- One Community Based Organization (CBO) or Non-Governmental Organization (NGO) focused on serving the education needs of the Hispanic Community
- Community College
- 4 year HSI or AMI, including required participation of the institution's College of Education
- 4 year Research extensive HSI, AMI, or Partner Institution
- Business Community Representative

➤ *would have the following Key Staff:*

- Principal Investigator
- Co-Principal Investigators (2)
- Program Staff (2)
- Evaluator
- School District Staff: Assistant Superintendent and/or Assistant Principal
- HSIs: STEM Faculty, Curriculum Directors, Deans, Vice-President or Vice Provost, Student Support Services Staff, Community Relations Staff
- Parents' Representative and/or Liaison
- CBO or NGO Representative
- Academic Advisors/Counselors
- Summer Bridge Program Faculty
- Undergraduate Mentors
- Graduate Mentors
- Laboratory/Research Faculty or Principal Investigators

➤ *would have the following Key Activities and Programs:*

- Training/Mentoring
- Retention Programs
 - Summer Bridge Program: High School to Community College or University
 - Summer Bridge Program: Community College to University
- Community/Family/Parent Outreach Programs
 - Parent Workshops on Careers, Financial Aid, College Preparation Curriculum, etc
 - Advertising and Marketing
 - Community Outreach on STEM Careers
 - Keynote/Role Model Speakers
 - Parents' Club/Organization/Support Group
 - Cultural/Cross Cultural Workshops on Education and Higher Education
- STEM Curriculum Articulation teams: K-5 to Middle School, Middle School to High School, High School to College/University, 4 year college/university to Graduate School, and K-20 articulation team.

➤ *would have the following other Key Activities and Resources:*

- Equipment for laboratories, summer bridge programs, parents' workshops
- Travel funds for faculty and students to attend conferences and training
- Research supplies and materials
- Evaluation and site visits

Implementation would be in two phases:

Phase One: A one year planning phase, with eight (8) \$50,000 planning grants awarded (\$400,000)

Phase Two: Award and implementation phase, two awards of \$2,000,000 each for five years for centers (\$200,000 per year per center)

Additional funding would be allocated to HACU for coordination of planning, site selection, implementation, evaluation, and dissemination.

Appendix: Barriers to Success in STEM Education

The specific barriers are listed below for **Undergraduate Barriers:**

- Lack of adequate high school and middle school preparation
- Lack of awareness/information for high school students and parents on Science/Technology careers
- Lack of information programs/activities for parents
- The drop in students' performance in the transition from elementary to middle school (lack of adequate teacher prep and transitional program designs mentioned as causes)
- Lack of college preparation programs
- Mathematics apprehension (usually begins in middle school)
- Parents discouraging their child's education beyond high school and even 9th grade
- Students and parent's feelings of being technologically deficient, especially with regard to computers
- Student's social responsibility (e.g., need to work to help family financially)
- Lack of efforts to motivate students effectively
- Traditional "advertisement" of careers in math and computer science that does not inspire students
- High drop out rate for Hispanic males at 9th grade (Identified the drop out rate's connection to students' difficulty in Algebra I, recent Mexicans immigrating from smaller villages where education beyond early high school is discouraged for economic reasons; early pregnancy; English Language challenges even with recent immigrants well prepared in Math)
- Teachers' apprehension of math/science
- Lack of effective parent outreach programs
- Lack of adequate career/academic advising in middle school and high school
- Middle school and high school counselor overload; student to counselor ratio is too high
- Lack of adequate academic advising at the college & university level

- Advisor's lack of awareness of math/science career opportunities
- Most faculty advisors at college level are not trained to do effective counseling (Family, cultural, cross-cultural, and economic issues as well information on community resources, etc.)
- Financial aid paperwork/forms
- Lack of information on financial aid
- Lack of effective advertisements on bridge programs/activities (e.g., of bridge programs & their potential participants;-Students/parents don't get info/application
- Lack of bilingual counselors
- Expectations of students not stated or shared with the students
- Faculty working from "weed out" perspective rather than "teach/success" mode
- Lack of pedagogical training for university instructors
- Lack of remedial programs to bring high school graduates "up to speed"
- Difficulty in teaching parents in assisting students to relate math/science to everyday life and the lack of mathematics programs/tools to encourage this (possible solution discussed: use of social workers/ community support resources)

Discussed as issues needing more examination/study:

- Education pathway; K-16 pathway (MESA, Proyecto Access and Tex Prep programs mentioned as possible models)
- The role high schools and colleges & universities have in addressing K-16 pathway problems
- Challenges in getting information out to "front line" faculty and staff
- Lack of role models
- Cultural barriers (students not being able to "go away" to college and participate in internships)
- Lack of research infrastructure for undergraduate students

Specific Barriers addressed for **Graduate Programs**.

External barriers:

- Lack of applicants
- Poor mentorship and networking (lack of relevance to community, perception of low salary, lack of understanding of the Hispanic community)
- Lack of role models
- Lack of visibility
- Lack of understanding of Hispanic culture
- Cultural barriers to careers and perception of gender roles
- Cultural approaches to debt
- Lack of educational tradition

Intrinsic barriers:

- Selection process (GRE as predictor of success)
- Poor foundation in the sciences

- Lack of cultural relevance in STEM areas
- Low expectations from self and others
- Length of degree program
- Lack of peer support (feeling of isolation; not being aware of scientific/academic environment)
- Lack of research facilities
- Lack of familiarity with science as a career choice
- Perception of hostile/unfriendly P.H.D. programs
- Geographic barriers
- Promotional structure within the university

Barriers to Ph.D. Completion:

The Graduate subcommittee identified the following as the primary causes for the lack of Hispanic students enrolling and completing a Ph.D. program (In descending order of importance):

1. Lack of applicants (very low numbers) to the programs
2. Poor academic foundation in Science
3. Lack of mentoring and networking with faculty/other students
4. Lack of role models/Lack of visibility prominent Hispanics in Science
5. Lack of familiarity with science as a career choice
6. Lack of funding
7. Selection Process (GRE as only predictor of success)
8. Lack of research facilities
9. Length of Ph.D. degree program
10. Isolation; unfamiliar with academic scientific environment
11. Perception of Ph.D. programs as unfriendly or even hostile
12. Promotional/advancement structure and culture in academia

The Graduate subcommittee also identified the following barriers as **cultural barriers**:

1. Ph.D. study lacks relevance in the community
2. The perception of Ph.D.s receiving low salary
3. Perception of gender roles
4. Lack of higher education tradition
5. Lack of cultural relevance of STEM areas
6. Low expectations by self and others
7. Lack of peer support
8. Geographic/cultural barriers