AC 2009-570: SUMMER BRIDGE: A STEP INTO THE ENGINEERING GAP

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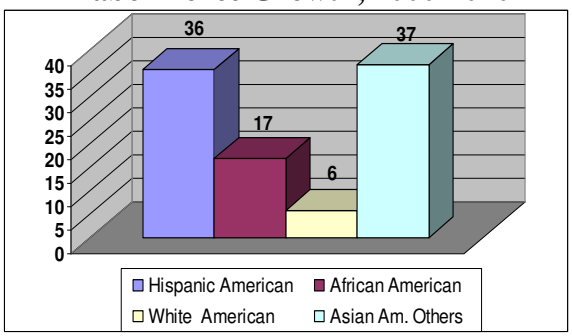
SUMMER BRIDGE: A STEP INTO THE ENGINEERING GAP

We face a major demographic imperative. The U.S. Census Bureau projections show a steady decline in the White population (from 81% in 2000 to 72.1% in 2050); a slight increase in the African American population (from 12.7% in 2000 to 14.6% in 2050), and a large increase in the Hispanic population (from 12.6% in 2000 to 24.4% in 2050)[1]. As indicated by the near term projections in the Labor Force Growth, 2000-2010 graph below, it is clear that the science and engineering workforce of the future must come from the ranks of currently under-represented groups.

Labor Force Growth, 2000-2010



(Occupational Outlook Quarterly, Winter 2001-02)

In fact the following data shows that "underrepresented minorities now comprise over **25%** of the U.S. Population, yet still comprise only **6.4%** of total engineering labor force."[2] While this data is especially true for racial/ethnic/gender minorities identified as Native American, African American, Hispanic; Asian Americans, which comprise 3.6% of the U.S. population, are well represented in the U.S. engineering labor force at 10.9% overall and 15.7% by gender. It should be noted, however, this data does not differentiate among distinct Asian American ethnic/cultural groups within the United States.

US Population By Race/Ethnicity	
Native American:	0.7%
African American:	12.1%
Hispanic:	12.5%
Asian American:	3.6%
Non-Hispanic White:	69.1%

(2000 US Census)

US Engineers in Labor Force By Race/Ethnicity	
Native American:	0.3%
African American:	2.6%
Hispanic:	3.5%
Asian American:	10.9%
Non-Hispanic White:	82.7%

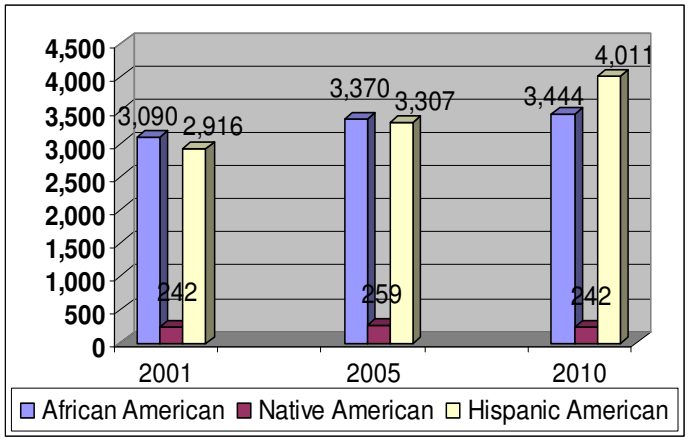
(National Science Foundation, 2000)

Ethnicity of Women B.S. Engineers, 2000	
Hispanic:	8.5%
African American:	9.1%
Native American:	0.7%
Asian American:	15.7%
Non Hispanic White:	65.9%

(Engineering Workforce Commission, 2001)

In an effort to address the underdevelopment of our engineering talent pool, it must become an important national priority to tap into the large pool of potential human resources in the U.S. It is imperative to increase the numbers of Women, African Americans, Hispanics and American Indians who follow STEM educational pathways in high school, major in science, math and engineering in college, continue on to pursue graduate degrees in these disciplines and eventually enter the science and engineering workforce as researchers, academicians and practitioners. The exigencies of diversity which are economic and technological, as well as, social and moral cannot be ignored as the demographic population shift that is projected to take place has already started. This can be seen in the school age population of underrepresented groups in the following 2000 U.S. Population Census Graph and State Growth Projection.

Population Shifts, 2001 – 2010, Ages 15-19



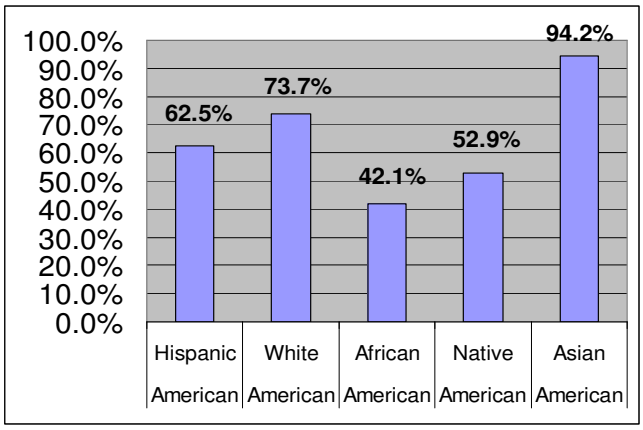
(2000 U.S. Census)

Fastest Growing States High School Age Population, 2000-2010	
Nevada	**70%**
Arizona	**48%**
North Carolina	**31%**
Florida	**28%**
Georgia	**23%**
Connecticut	**23%**
California	**20%**
Massachusetts	**21%**

(2000 U.S. Census)

Retention on a national scope, in higher education, is defined as the percentage of enrolled students at a college or university who achieve satisfactory results and return to campus after their first year (i.e. matriculation to official sophomore status), which positively impacts their persistence toward graduation and earning their degree. However, this challenge of retention is significantly greater for underrepresented minority students than their white or even Asian American counterparts, as seen by the NSF/EWC Retention of B.S. Engineering Students Graph.

Retention of B.S. Engineering Students



(NSF/EWC, 2002)

In order to retain minority students several researchers contend that the campus must provide a warm, supportive and nurturing environment from the moment these students arrive on campus. Many colleges and universities have established various intervention models in an attempt to retain underrepresented minority students. Despite this effort, underrepresented minority students continue to fall below the requirement to matriculate to sophomore status. "This disparity is even more pronounced among African American males relative to African American females."[3]

In an effort to deal with this challenge of increasing the recruitment and the retention of underrepresented populations many universities have investigated various methods. One such method or undertaking is **mentoring**. In their study, Lavant, Anderson & Tiggs (1997)[3] show how mentoring is a valuable and effective tool where mentoring already has a long tradition in education and allows the mentor to serve as a guide in introducing the mentee to the new environment he or she is about to enter.

Numerous studies report that the interaction of faculty and students is an important determinant of student retention and may therefore be especially critical for underrepresented minority students.

Mentoring from a higher education perspective has been defined as an intentional process where role modeling is expected and requires direct interaction between the mentor and the protégé. Although the research on mentoring in higher education for underrepresented minority male students is sparse, Astin (1984)[3] stresses the importance of student participation in the mainstream of campus life.

The literature, however, does suggest that it is very difficult to mainstream underrepresented minority (male) students into mainstream campus life, thus making it even more important to actively have a formal mentoring process to involve them in.

In an effort to examine the perceptions and attitude of undergraduate African American students on mentoring, eighteen African American students (11 women and 7 men) were interviewed and surveyed after participating in a nine week summer research mentoring program at a large university. The study attempted to address two questions:[3]

1. What type of student-faculty relationships are expected for those students in formal programs?
2. What associated effects does faculty's race or gender have on the perceptions and attitudes of underrepresented minority students participating in "mentoring" programs?

The interview results were quite telling. Those with black or women mentors had more positive perceptions and attitudes toward research and the research environment than those with white male counterparts. These findings help to highlight the importance of having faculty that the students can strongly identify with, thereby providing the students with a heightened positive attitude toward both research and academic careers.

In this study[3] several mentoring models (i.e. The Black Man's Think Tank, The Student African American Brotherhood (SAAB), The Black Male Initiative, The Meyerhoff Program, The Bridge, Project BEAM, etc.) were identified and referenced for their effectiveness. While many of these mentoring programs primarily focus on the underrepresented minority freshman undergraduate, the Meyerhoff Program's primary purpose is to increase the number of African American men who earn doctorates, in engineering, medicine, and the sciences. The Meyerhoff Program helps to highlight the similarly stagnating fate that blacks at the graduate and professional school level continue to still face and how this problem doesn't go away even after having secured their undergraduate degree.

While Lavant, Anderson & Tiggs (1997)[3] refer to the mentoring process as an interaction between two or more individuals. They rightly concluded in their summary that there must be a combined and collaborative effort between several participants. This collaborative effort must include administrators, faculty, staff, community leaders, and parents who must continuously strategize and implement programming that positively affect the retention of these students, especially the African American male student, immediately upon arrival to college and university campuses.

In conclusion, mentoring appears to be an effective tool in helping many students, but particularly historically underrepresented students, to overcome the barriers that oftentimes prevent them from completing college successfully. Mentoring helps to empower underrepresented students to develop into and become role models that can help to create a cycle of success, within higher education, that in turn ultimately benefits all of society.

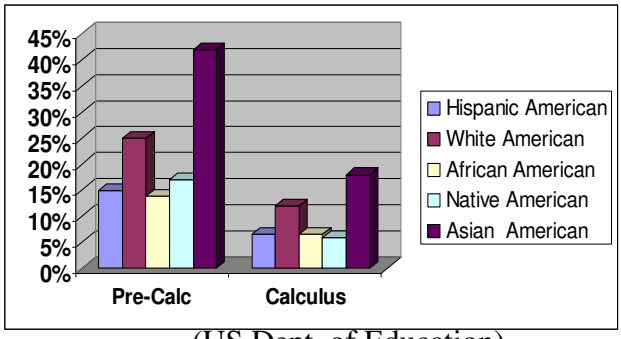
There are social cognitive factors that may hinder the academic achievement of URM students in science and engineering which also need to be taken into consideration. Some scholars and educators have predicted that the barriers that discourage underrepresented minorities from achieving success in science and engineering, pointed to such factors as:

- inadequate academic preparation
- substandard educational resources
- mismatched social and academic expectations
- lack of encouragement
- psychological intimidation
- unstable familial and financial circumstances
- inadequate peer support
- lack of role modeling/mentoring
- low expectations by science and engineering faculty
- poor/uninspired instruction and advising by science/engineering faculty
- racism

(Reichert & Absher, 1997)[3]

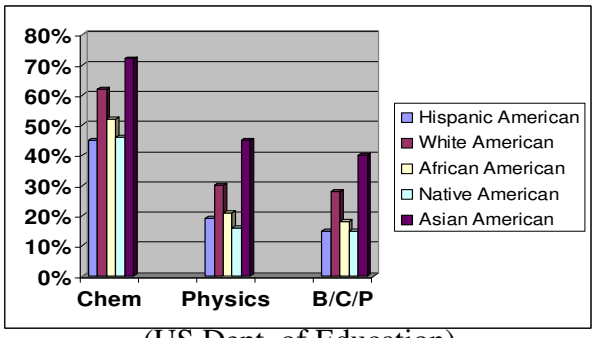
Mathematics and science are the primary languages of science, technology, engineering and mathematics. Students with inadequate grounding in mathematics and science, as seen in the graph from the US Dept. of Education, are not well prepared for future academic and/or career opportunities, resulting in some colleges and universities experiencing difficulties in their recruitment efforts for under-represented minority (URM) students. In addition, they may find an even greater burden to not just recruit but to retain underrepresented students in their engineering program(s).

Percent of Graduates
High School Science Classes



(US Dept. of Education)

Percent of Graduates
High School Math Classes



(US Dept. of Education)

It is precisely because of the challenges highlighted earlier in this paper that the underrepresented minority students and the institutions of higher learning they are accepted into must work pro-actively to counteract both the social cognitive factors and the inadequate academic grounding.

The Northeastern University Program in Multicultural Engineering (NUPRIME) is committed to cultivating and supporting diversity and academic excellence in the study of engineering at Northeastern University. NUPRIME helps provide an access point, for historically underrepresented students, into the education pipeline to diversify the pool of

engineers in the work force and in academia. The Northeastern University Program in Multicultural Engineering recognizes that talent and opportunity alone are not sufficient to support these students in their quest for a college education and professional aspirations. A long term commitment to recruitment, **retention**, **mentoring**, financial support and academic opportunities is required.

In an effort to address the social and/or cognitive factors that may hinder the academic achievement of URM students in science and engineering, the Summer Bridge Program provides a first step in helping to set students up for success, especially students who are identified by the National Science Foundation (NSF) as historically under-represented students (African American, Hispanic and Native American). After having qualified for admission into the College of Engineering, we help these self-selected students to begin the process of moving ahead of the curve in the demands of an engineering curriculum.

These students are encouraged to develop cohort relationships with each other, while having the opportunity to work with our physics, math, chemistry and engineering faculty. Students are exposed to upper class, graduate engineering students and faculty as mentors. Students are taught how to develop effective self advocacy skills and the intrinsic value in being one's own best advocate.

NUPRIME demonstrates this commitment by providing an annual GAP (Generating Academic Performance) Summer Bridge Program. The GAP Bridge Program seeks to provide a first step on the road to success for historically under-represented students who have qualified for admission and who will be attending the College of Engineering (COE) in the upcoming Fall Semester. Participants interact with University faculty, staff and students in a variety of academic, mentoring, social and leadership development activities. The GAP component includes workshops that provide a preview of calculus, physics, and chemistry as well as hands-on engineering demonstrations to set the students up for a head start to success in a demanding engineering curriculum and then provides dedicated academic support during the academic freshman year. Additionally, Summer Research Experiences for Undergraduate opportunities are available at the conclusion of the student's freshman year.

Our Summer Bridge GAP Program has yielded encouraging quantitative and qualitative results. These results include the recruitment, retention, graduation and post-graduation performance of the 2003 Summer Bridge cohort that graduated in 2008, in addition to each previous and succeeding Summer Bridge cohort. We will discuss the Summer Bridge Program strategies, implementation methods, outcomes and on-going development, and will reference back to the national data which informs our need to provide achievable and measureable responses to this national concern.

The Steps taken to begin the process of supporting URM students include but are not limited to the following:

- Identify and recruit academically prepared, historically under-represented students for COE undergraduate
- Identify scholarships and nominate academically strong, yet financially challenged, historically under-represented engineering students

- Formulate and implement academic success support programs for traditionally under-represented students (e.g. **Summer Bridge Program**)
- Develop collaborative research (undergraduate/graduate) opportunities for under-represented students to take advantage of at the end of their freshman year via NSF ERCs, NASA Research Labs, LSAMP, and independent faculty research area(s).

- Advising role to NSBE (National Society of Black Engineers) and SHPE (Society of Hispanic Professional Engineers) student chapters in partnership w/ Advisor to SWE (Society of Women Engineers) and Director for Women In Engineering (Rachelle Reisberg)

- Leadership Development - Summer Bridge Student Presentation @ Annual COE Student Leadership Retreat (i.e. – IEEE, ASME, IIE, ASCE, EWB, AIChE, NSBE, SWE, SHPE,

- Corporate/Cooperative Educational Partnership

- Cohort Relationship Development - Team Building Ropes Challenge Course Activities

- Mentorship **-** Academic, Social, Cultural, Developmental, Organizational

Gateway/Engineering Academic Summer Bridge Preview

- Calculus
- Physics
- Chemistry
- AutoCAD
- Civil Engineering/Earthquake Simulation

- 2002 Summer Bridge Highlights
  - 11 self-selected students participated
  - First Year Student Success examples:
    - Summer Bridge Student was 1 of 3 students, university wide, awarded the coveted Charles Irwin Travelli Full Scholarship
    - A freshman student achieved 2.75 GPA overall, after only achieving a 1.8GPA at end of the Fall Qtr. (Student is now pursuing an M.S. Degree in Mechanical Engineering at Howard University)
    - Student accepted into the honors program has continued to maintain honors status at the end of the first year

- 2003 Summer Bridge highlights
  - 14 self-selected students participated
    - 2 - Dean's Scholars
    - 3 - Excellence Scholars
    - 2 - Achievement Scholars
    - 3- Summer Research Experiences for Undergraduates (SREU)

- Added Corporate site visit to Co-op Partnership
  - Teradyne Company provided presentation & tour
- Added new academic preview module
  - Chemistry/Chemical Engineering

- <u>2004 Summer Bridge highlights (Funded by Distinguished Engineering Alumnus)</u>
  - 10 self-selected students participated
    - 2 - Dean's Scholars
    - 2 - Achievement Scholars
    - 3 – Research Experiences for Undergraduates

  - **Introduced non-URM "first generation college women"**
    - **3 non-URM students accepted invitation to participate**
    - **Added to provide add'l female cohort for URM women**

- <u>2005 Summer Bridge highlights</u>
  - 21 self-selected students participated
    - Several students are Dean's Scholars
    - Several students are Achievement Scholars
    - 6 – Research Experiences for Undergraduates

  - 95% Freshman Retention Rate / 90% Engineering Retention Rate

  - Declaration of Major: (Note: There is some rounding error)
    42% EE or ECE
    26% Civil Engineering
    16% Chemical Engineering
    5% Mechanical Engineering
    5% Industrial Engineering
    5% Arts & Sciences

  - Average GPA:
    3.0 – 4.000: 47.6%
    2.5– 2.999: 14.2%
    2.0 – 2.499: 14.2%

- <u>2006 Summer Bridge highlights (Funded by Corporate Sponsor)</u>
  - 22 self-selected students participated (7 Female/15M)

  - 16 Students were merit-based scholarship recipients
    - 2-Honors Students,
    - 2-Deans' Scholars,
    - 2-Lewis Scholars,
    - 9-Achievement Scholars
    - 1- Torch Scholar
    - 5- Research Experiences for Undergraduates

- Site visit to Raytheon-IDS
  - 1) Tewksbury, MA 2) Andover, MA

- 95% Freshman Retention Rate / 90% Engineering Retention Rate

- Average GPA:
  3.0 – 4.000: 57.0%
  2.5– 2.999: 19.0%
  2.0 – 2.499: 5.0%

- 2007 Summer Bridge highlights (Funded by Corporate Sponsor)

  - Student Participants
    - 15 self-selected students participated (7 Female/8 Male)
    - 15 Students were merit-based scholarship recipients
    - 2-Lewis Scholars, 2-Honors Students,
    - 2- Deans' Scholars, 9-Achievement Scholars
    - Torch Scholar
    - 4 – Research Experiences for Undergraduates

  - Site visit to Raytheon-IDS
    - 1) Tewksbury, MA 2) Andover, MA

  - Declaration of Major: (Note: There is some rounding error)
    29% EE or ECE
    7% Civil Engineering
    29% Chemical Engineering
    21% Mechanical Engineering
    7% Industrial Engineering
    7% Arts & Sciences

  - 100% Freshman Retention Rate / 93% Engineering Retention Rate

  - Average GPA:
    3.0 – 4.000: 50%
    2.5– 2.999: 36%
    2.0 – 2.499: 7%

- 2008Summer Bridge highlights (Funded by Corporate Sponsor)

    - Student Participants
        - 22 self-selected students participated (11 Female/11 Male)
        - TBD Students were merit-based scholarship recipients

    - Site visit to Raytheon-IDS
        - Andover, MA

    - Summer Bridge Barbeque
        - Corporate Sponsor Keynote Speaker:
            - Dir. Supply Chain/MSME/Harvard MBA/African American Male

    - Research Experience for Undergraduate EOY Summer Bridge participants-TBD
    - Student Leadership/Organizational Activities - TBD
    - TBD Freshman Retention Rate / TBD Engineering Retention Rate
    - Declaration of Major: TBD
    - Average GPA: TBD

Typical Research Opportunities for:
End Of Freshman Year Summer Bridge participants

Gordon CenSSIS Engineering Research Center:
(Research Examples)
Corey Ashby/Eric Miller (ECE) –
"Software design locating buried unexploded ordinates at military sites."

William Price/Cary Rappaport (ECE)-
"Computational Modelling of wave propagation for soil bed."

Stanley Cantave/Akram Alshawabkeh (Civil Engineering)-
"Experimental research on 2-D wave propagation thru complex dispersive Media using soil bed facility."

CHN Engineering Research Center: Center for Highrate Nanomanufacturing

*CAMMP NASA Research Center:*Center for Advanced Microgravity Materials Processing

BACK TO THE BEGINNING WHERE IT ALL STARTED
AND WHERE ARE THEY NOW!!!!

College of Engineering
Fall 2003 Incoming Freshman Profile

	All	URM
SAT - Total	1253	1192
SAT - Math	655	617
SAT - Verbal	598	575
GPA	3.6	3.5

College of Engineering
First Year Academic
Performance Comparison

URM =
Under-represented Minority

Summer Bridge & Non-Summerbridge	2003 Summer Bridge URM	2003 Non-Bridge URM	2003 All
College GPA	**2.92**	**2.56**	**3.09**
%GPA >= 2.0	**92%**	**76%**	**93%**
%GPA >= 3.0	**53%**	**28%**	**63%**
% >= 600 SAT- M	46%	72%	NA
SAT-Total	1168	1204	1250

Graduates of Summer Bridge Program

Bridge Year	Retention Rate	Frosh Avg. GPA	Graduation Rate
2002	82%	3.020	100%
2003	86%	2.759	92%
2004	90%	2.831	TBD
2005	95%	2.939	TBD
2006	93%	2.877	TBD
2007	100%	2.986	TBD
2008	TBD	TBD	TBD

This graph reflects those students who came through the 2003 Summer Bridge Program experience and have completed their degree requirements and have selected to go to graduate school and/or enter the engineering work force.

2008 Graduates of 2003 Summer Bridge Program

Last Name	First Name	Gender	Major	Degree	Status – 5 years later as Class of 2008
African Amer.		M	Elec./Comp.Eng.	BS ECE	MS/PhD Program at Johns Hopkins Univ. and GEM Fellow
Hispanic Amer.		M	Civil Eng.	BS Civ.E.	Hired by Civil Engineering Firm
African Amer.		F	Chem. Eng.	BS Chem.E.	In Training for Teach America Program as Science Teacher in North Carolina
Hispanic Amer.		M	Mech. Eng.	BSME	Hired by Hasbro Co.
African Amer.		M	Mech. Eng.Tech.	BSMET	Hired by Environmental Engineering Co.
African Amer.		M	A&S	WLS	Withdrawn due to low scholastic performance
Hispanic Amer.		M	N/A	N/A	No Show at NEU after Summer Bridge Program
Hispanic Amer.		F	Civil Eng.	BS Civ.E.	New York City Civil Engineering Department
Hispanic Amer.		M	Mech. Eng.	BSME	NSTAR Engineering Leadership Development Prog. (ELDP)
African Amer.		F	Comp. Eng.	BS Comp.E.	Hired by Raytheon Co.
African Amer.		M	Comp. Eng.	BS Comp.E.	Hired by IBM
African Amer.		F	Chem. Eng.	BS Chem.E.	MS/PhD Program at Pursuing Genomics at Columbia University MS
Hispanic Amer.		M	Elec. Eng.	BSEE	Currently interviewing w/ Raytheon Co.
African Amer.		M	Comp. Eng.Tech.	WLS	Withdrawn due to low scholastic performance

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1. U.S. Census Bureau, 2004, U.S. "Interim Projections by Age, Sex, Race and Hispanic Origin," Internet Release Date: March 18, 2004

2. CPST, derived from U.S. Census Bureau 2000&Engineering Workforce Commission, 2000

3. LaVant, B.D., Anderson, J.L., & Tiggs, J.W. (Winter 1997) Retaining African American Men Through Mentoring Initiatives. *New Directions For Student Services, 80, 43 – 53*