

DIVERSITY: THE CHALLENGES FOR ENGINEERING AND TECHNICAL EDUCATION

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Abstract – Diversity has become a watchword throughout western culture, and this is true in no area more than education. Most will agree that diversity is of critical importance in our culture, and that, in the long view, programs benefit greatly from the effort to achieve such goals relative to the makeup of the student body as well as the faculty and staff. What are the obstacles to diversifying the student population? They come in many shapes, and are deeply rooted in matters of funding and historically accepted selection and evaluation criteria. Diversification of faculty and staff can be equally challenging and more of an ongoing issue, as well. While legal battles continue over the specific responsibilities and practices of educational institutions in these matters, financial resources stretch thin during this difficult economic time. In order to effectively diversify in the face of these issues, engineering and technology programs must first study the relevant statistics and develop an understanding of the issues, including criteria for enrollment and evaluation, learning methods, and financial support.

Introduction

Of the challenges universities and higher education face today, diversity of student and faculty populations is among the most difficult and controversial. Although the mainstream thinking in political and academic circles generally embraces diversity as a worthwhile goal, little unanimity exists with respect to the mechanisms by which to accomplish it and the means by which to measure the success of such efforts. In recent days, the selection process utilized at the University of Michigan has been scrutinized and criticized by the White House, highlighting the differences of opinion that exist on the subject.

Again, the issue of affirmative action has come to the forefront. In order to develop an understanding of the issues, the rationale for diversity must be addressed, then an examination of current day events viewed against the historical backdrop of significant court decisions and legislation will help provide a context for discussion of the challenges universities must confront on the subject of diversity. To begin, a definition of diversity is necessary.

Diversity Defined

In years gone by, the term minority student might have generally implied African-Americans. However, population growth and immigration to the United States have led to much stricter definitions of minority groups. According to Elazar Barnette [2], minorities may be grouped under the larger headings of African-American, Hispanic, Asian-American, and American Indian. Each of these groups may confront different obstacles to access of and success in higher education.

Rationale for Diversity

What are legitimate reasons for policies and programs with the goal of diversification? For many in academic circles, the answer to this is simply that it is the right and proper thing to do, without thought for further justification of such efforts. Many Americans view education as the primary means by which to liberate people from poverty and to elevate the quality of life. If, as a people, it is agreed that all are entitled to life, liberty, and the pursuit of happiness, and that discrimination based on race, or ethnicity is wrong, then the case for diversity is easy to make and defend.

Enacting a universally accepted policy of diversity is, nonetheless, difficult. Enrollment at any given university is capped by a number of limiting resources, which leads to the selection of some and the rejection of others. Those who are rejected for admission may then argue against overt criteria that are viewed as providing an unconstitutional advantage to those of minority or ethnic background. This was the case in *Hopwood v. Texas*, according to Jorge Chapa and Vincent Lazaro, when four white students denied admission to the University of Texas Law School filed suit in 1992 [3]. The results of this case had far reaching implications for several states the institutions of which had previously promoted some level of diversity.

The Impact on Minorities and Society

In view of such arguments, it is important to develop an understanding of other, compelling reasons that support the goal of diversity. Evidence shows clearly that those who avail themselves of higher education tend to fare better in many different ways. The more highly

educated enjoy a higher standard of living and longer and healthier lives. For instance, data collected in the *Digest of Education Statistics* shows that among Blacks 20 – 24 years of age, those with only a high school diploma are unemployed at the rate of 16.4%. For those in that group who earned a college degree, the rate of unemployment fell to 5.7%. Similar statistics hold true for other minority groups, as well [6]. Authors of *Closing the Education Gap* make a compelling argument that diversity benefits society. Data they report indicates a direct correlation between higher education of minority groups and decreased public expenditures to support them on a per capita basis. Among Black men, for instance, these savings amount to nearly \$1,000 annually for college graduates as compared to high school graduates. A Mexican woman who completes a college education would add \$1,398 in public revenue annually and enable a public programs savings of nearly \$1,000 over her high school graduate counterparts [21].

Some will maintain, however, that while pursuit of diversity may improve the lot of minority groups pursuing higher education, the selection criteria utilized will eliminate a number of students with better academic credentials and greater promise for achievement. These arguments have been used, at least in part, to challenge admissions policies that place a value on minority status. If selection criteria include factors for minority inclusion, do they not then dilute the academic pool and limit the education potential for all by eliminating some with greater promise? Countering this argument, data gathered by the University of Michigan available on-line supports the anecdotal evidence cited by educators that learning for all students is improved when the population of students is more diverse [16].

The evidence put forth in these University of Michigan studies makes an even stronger case: “students who experienced the most racial and ethnic diversity in classroom settings and in informal interactions with peers showed the greatest engagement in active thinking processes, growth in intellectual engagement and motivation, and growth in intellectual and academic skills” [16]. In other words, diversity is of educational benefit to all, not simply the minorities who take advantage of the opportunity afforded to them. As reported by Marc Geller, David Swain, Boeing chief technology officer and executive vice president of engineering and technology, says that diversity in the workforce increases the “likelihood of developing the best ideas”. This company and many others support diversity in hiring, and agree that it supports their bottom line [9].

Generally speaking, even those who argue the most vehemently against affirmative action offer at least tacit agreement with these views. Unfortunately, there are still those whose motivation to resist the promotion of diversity has simply supplanted their now-politically-unacceptable views that in earlier days supported

segregation. These voices continue to be heard in legislatures and courtrooms across the county.

For those who continue the argument that a policy of diversity is simply the right thing to do, some statistics support the thinking that overt efforts are absolutely necessary for the good of society. According to recent data reported by Ron Fourier, over 70% of Black and Hispanic students attended predominantly minority (elementary and secondary) schools during the 2000 – 2001 school year. Given that the make up of the general population is now approaching 40% minority (defined as non-white), it is clear that public schools are not effectively integrated. Gary Orfield, co-director of Harvard’s Civil Rights Project, states that the resegregation of public schools is undermining the quality of education minority children receive [8].

Will simply increasing the number of white faces improve the quality of education in these schools? Ron Fourier further reports that Boston University professor Christine Rossell argues against this position and further states that improving the resources available to teachers, having smaller classes, and better teachers will lead to improved academic performance, not simply integration of the student population [8]. Therefore, while white faces don’t necessarily mean a better education, overall improvements may come about indirectly with increased Caucasian enrollment as a result of higher per student funding.

Some Historical Background

The demographics of university enrollment prior to the 1960s reflected persistent segregation policies. Major changes began with *Brown v. Board of Education* and continued in the Civil Rights Act of 1964. Court rulings, legislation, statistics on minority enrollment and demographics, and differences among minority groups provide a framework for understanding the issues surrounding diversity.

Court Rulings and Legislation

Many court rulings and legislative acts have impacted on issues of segregation and diversity. Only a few of the more significant will be discussed as they pertain to the topic under discussion. The 1964 Civil Rights Act was landmark legislation. In it, section 601, Title VI states: “No person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance.” Given that virtually all institutions of higher education relied on federal funding at some level, this legislation worked to end discrimination based simply on race or ethnicity.

However, while Title VI certainly marked a turning point for minorities seeking access to higher education, the door had only been unlocked, and was not yet open. Some universities, particularly highly selective institutions, continued to apply admission criteria based primarily on academic achievement and standardized test results that had the effect of eliminating minority students en masse.

While Title VI disallowed discrimination, it did, however, empower institutions to treat people differently based on race or ethnicity *if there was a compelling reason to do so*. A legitimate reason, says author Christopher Edley, could be to remedy racial discrimination that existed at an institution of higher learning [7]. Beginning then, many universities began to apply this interpretation to mold admission policies in such a way as to increase the enrollment of minorities. As a result of these efforts and with the support of increased federal financial aid, African-American enrollment increased in comparison to white enrollment until it peaked around 1978. Nonetheless, minority enrollment and retention in engineering and technical programs continued to lag far behind that of the general population, due, many agree, to selection criteria that are racially biased.

Following a few short years of slow improvement in minority enrollment, challenges to affirmative action began to impact the approach that institutions applied to minority admissions. Most notable among these was the Supreme Court decision of 1978 in *Regents of the University of California v. Bakke*. The prevailing concept scrutinized by the Court in this case was the rigid minority enrollment philosophy practiced by the Davis Medical School at the University of California. The Supreme Court decision struck down what was largely viewed as a racial quota system, but did allow universities to continue the use of race as one of a number of determining factors for admission. Furthermore, in rendering this decision, Justice Powell stated, “the nation’s future depends upon leaders trained through wide exposure to the ideas and mores of students as diverse as this Nation of many peoples.” He also recognized that each university should have the freedom to make choices about the composition of its student population in order to achieve its mission, according to Christopher Edley [7]. Many institutions of higher learning have agreed on this issue, and some effort has been made to develop admission policies and financial aid to support the inclusion of minorities.

For a number of years following the *Bakke* decision, little political or legal opposition was directed towards admission policies that encouraged increased diversity. During this same period, however, immigration was changing the face of demographics in many states, and this was nowhere more the case than in California and Texas.

In 1992, four white students denied admission to the University of Texas Law School filed suit, arguing that race-based admissions policies were unconstitutional. In the decision handed down by the Federal District Court Judge Sparks ruled that it was not permissible to determine admission solely on the basis of race. Although the ruling did not deny the importance or legitimacy of some existing diversity efforts, the immediate negative impact on minority applications and admissions was predictable and significant. The number of blacks and Hispanics enrolling at Texas A&M in 1997, the first year following the decision, dropped 12% and 10%, respectively. This decrease followed what had been five years of steady improvement. In 1996, the Fifth Circuit Court issued a reversal of Judge Spark’s ruling that essentially eliminated the use of race or ethnic background as a determinant for admission’s policies. The arguments made in this case were based to some degree, state Jorge Chapa and Vincent Lazaro, on the findings of the U.S. Fourth Circuit Court of Appeals decision in *Podbersky v. Kirwan* that a scholarship the eligibility for which was based solely on race was unconstitutional [3]. Scholarships that had supported minority participation began to decrease along with enrollment numbers for minority groups, in general. Clearly, other scholarships that are based in least in part on membership in a minority group may be targeted for their exclusion of other population groups.

In the news lately has been the admission policy employed by the University of Michigan, which assigns a specific point value to membership in a racial or ethnic group, or a group with low socioeconomic status. The White House, reports Ron Fourier, has weighed in on the argument, asserting that the practice was “divisive, unfair and impossible to square with the competition [8]. The Supreme Court is scheduled to hear this case in March.

The Demographics of Minority Groups

The rapid growth of minority populations in the United States has led both to stronger efforts to diversify and more controversy over the means used to accomplish this goal. Authors of the *Statistical Handbook on Racial Groups in the United States* make some significant predictions, as indicated by the following demographics. Current projections are that the Hispanic population will grow from approximately 31 million in 2000 to over 41 million by the year 2010. The Black population is predicted to increase to over 37 million in 2010 from slightly over 33 million in the year 2000 [10]. It is significant to note that the Hispanic population will then be the largest minority group in the United States. It is also important to note, according to this same reference, that if the projections hold true, Hispanics and Blacks combined will outnumber Caucasians in the state of California and will rapidly approach that outcome in

Texas, as well. The case for diversity is and will continue to be driven by these demographic changes.

Differences among Minority Groups

With the continued growth of minority populations has come recognition of differences between the groups. African-Americans, Hispanics, Asian-Americans, and American Indians share some disturbing problems, particularly with respect to socio economic status, but also struggle with different obstacles as a result of cultural differences. Cultures, by their very nature, struggle to retain an identity, emphasizing those differences that they value and that make them unique. During the height of the early struggle against segregation in this county, one effect of the desegregation effort was to treat people with a “color blind” attitude, in the attempt to level the playing field. This “melting pot” philosophy essentially countered efforts to retain cultural identity, and, as a consequence, was resisted by many minority groups. The term eventually fell from the American vernacular as credence was given to retention of ethnic and minority identities

Unfortunately, while the term “melting pot” is no longer politically acceptable or applicable, the differences among minority groups continue to be misunderstood. Low rates of graduation from high school plague the Hispanic community, for instance, but the drop out problem for the Puerto Rican sub-group occurs much earlier, reaching 80% in junior high for some school districts. Puerto Ricans are a subgroup of Hispanics, which also includes the subgroups of Chicanos, Puerto Ricans, Central and South Americans, and Cubans. Of these sub-groups, Cubans generally have the highest income, while Puerto Ricans have the lowest. The statistics for these sub-groups, according to Barbara Astone and Elsa Nunex-Wormack, emphasize that the level of education achieved correlates directly with socio economic status [1].

The disparity in income levels of minority groups and in comparison with “White” income levels has changed, over the years. In 1980, for instance, Hispanic median income was approximately 16% higher than that of Blacks. By 1996, the gap had closed, and these two groups now earn approximately the same income. The Asian minority group, according to the Statistical Handbook on Racial Groups in the United States, actually has enjoyed a higher median income than all other population groups, including the white group [10]. Why is this? This same source of information indicates that in 1997 42.2% of Asian and Pacific Islanders completed four years of college or more. For white, black, and Hispanic, the completion rate that year was 24.6%, 13.3%, and 10.3%, respectively. These differences in educational attainment alone may explain the income gap among the racial and ethnic groups. If such a correlation holds true, it provides further rationale to pursue the

availability of higher education for all people. It should be noted that the income levels among minority groups are shifting, as noted earlier, and can be indicative of important trends. Institutions of higher learning should remain informed and sensitive to these changing demographics as they script diversity policy.

Concentrations of minority populations in a geographical area tend to raise the level of consciousness concerning these issues, and improve the opportunities for strengthening the cultural family. Higher education, however, tends to separate individuals from their cultural support mechanisms, creating another obstacle to diversity.

Obstacles to Diversity

Certainly, court decisions have significantly impacted on the mechanisms that universities employ to improve the educational opportunities for minority admissions. Nevertheless, even the most significant court decisions have included statements supporting the general philosophy of diversity. What are the difficult issues that higher education and particularly engineering and technical institutions face with respect to diversity? They include selection criteria, poverty, college readiness, retention, and budget shortfalls.

Selection Criteria

Without race as an admission factor, minorities may be completely at the mercy of other selection criteria that for years have been under fire for racial bias. These criteria have an even more chilling effect when the curriculum under discussion is engineering or technology based. Such programs often emphasize mathematic aptitude and success in science-related coursework, and consequently place great reliance on SAT or ACT scores for prediction of success. Admission criteria are generally selected to accurately identify those students who will have the best chance for success in college.

But do they? Robert Ibarra argues they do not. He makes the case that standardized tests are, by their very nature, racially biased, and analysis performed on the SAT seems to support this [13]. James Crouse and Dale Trusheim argue that using SAT scores for selection amounts to simply piling on the negative criteria as it applies to minorities [4]. One thing many agree about, report Barbara Astone and Elsa Nunex-Wormack is that minority groups, with few exceptions, suffer when evaluated under standardized testing due to the fact that those scores, and frankly the quality of education in general, are also related to socioeconomic status and the educational level attained by parents [1].

Income Levels of Minorities

An additional for minority groups generally is their disproportional representation among the lower income. Due to the fact that college readiness may be correlated to some degree with funding per student in secondary education, students in lower income brackets have two strikes against them: lower chance of qualifying for admission and the inability to pay for a college education. This situation may be compounded in states where secondary education is funded in large part by property taxes. Immigrant populations in California and Texas, for example, are attending now largely minority secondary schools. Does this not lead to lower educational experiences for these students who are socio economically disadvantaged? The same question must also be asked for racially segregated neighborhoods across the United States.

Retention and Success Rates

Complicating the issue of diversity is the dismal retention rate of minority students who manage to successfully run the admission gambit. Many plots play in this story, and some may bolster the claim that efforts at diversity simply lead to high failure rates for minorities who were not academically prepared for the challenge. As noted previously, minorities, when entering higher education leave their cultural support mechanisms behind, and the small number of minority faculty nationwide exacerbates this problem. The statistics for graduate degrees awarded to minority students tells an equally depressing story. According to United States Department of Education statistics, total masters of engineering degrees earned in 1999 – 2000 in the United States numbered 25,596, and of that number only about 1,500, less than 6%, were awarded to non-Asian minorities. Given that faculty members come from the ranks of those with advanced degrees, this information is not promising for increased representation of minority faculty in this area of academia. Similar statistics also hold for engineering-related technologies [6].

College readiness is very much a problem for minority groups, and this is specifically true for entry into engineering and technology programs. The reasons for poor college preparation may well be tied simply to the lack of resources that are a function of under-funded education in areas of poverty. Consider the data provided by the United States Department of Education in “Minorities in Higher Education” comparing the percentages of students in various race and ethnic groups taking calculus and advanced placement calculus courses in high school [20]. All groups show significant increases from 1982 to 1994 in enrollment in this important area of preparatory study for future engineering and technology students. Most remarkable is the increase for the Asian

group, from 18.3% in 1982 to 44.4% in 1994, an improvement for which no explanation is readily available. Student enrollment for Blacks increased from 1.6% to 5.8%, reflecting a change of 363%, highest of the groups. Although this is strong evidence that Blacks as a group are preparing themselves better, nonetheless, it means that less than 6 out of 100 black students were then preparing themselves to pursue college study which requires those abilities. As a group, blacks continued to lag behind all other groups reported.

Percentages of high school students enrolled in calculus courses:

	<u>White</u>	<u>Black</u>	<u>Hispan.</u>	<u>Asian</u>	<u>Am. Indian</u>
1982	7.2	1.6	2.1	18.3	4.1
1994	16.9	5.8	10.6	44.4	6.0

(Data summarized from reference #19)

While improvements are in evidence for all groups as reflected above, blacks, Hispanics and American Indians continue to fall behind in preparing themselves for challenging curriculum in the engineering and technology fields. Some of this problem may reflects back to the quality of education in poor school districts that is itself reflective of the socio economic trap in which some minority groups are captive.

The Impact of Budget Shortfalls

For those at or near the poverty line, paying for a college education in the best of times may be impossible. Unfortunately, these are not the best of times. It is common knowledge that the effects of a slow economy are felt first and worst by the income-disadvantaged. For those of lower income, state universities with relatively modest tuition costs have generally been the option of choice. As budget constraints begin to impact funding of state university programs, however, financial aid may well be among the first casualties of cost cutting.

According to reference Larry DeBoer, the current budget problems in the state of Indiana may well lead to such problems [5]. Funding for K-12 and higher education makes up more than 50% of the state budget. Revenue projections continue to indicate that collections will not meet expenditures in the future, and, therefore, budget cuts may soon be necessary. Given that two of the remaining large components of the budget have to do with entitlement programs and public safety, education programs may be among the first on the chopping block. Only if the state elects to delay scheduled property tax relief, thereby alleviating the revenue shortage, is it likely that such a scenario will be avoided.

What are the implications of a recession or slow economic times for minority enrollment? Success in diversity efforts has two major thrusts: increasing admissions and increasing completion rates. Regardless of the efficacy of diversity initiatives for increasing enrollment of minorities, if these students, many of whom are socio economically disadvantaged to begin with, are unable to afford to remain in school, the efforts will be for naught. Scholarship and grant funding levels should be adjusted to offset the disproportionate effect of the economic downturn on minority groups.

Diversity Efforts Today

While vocal opposition remains to the philosophical underpinnings of diversity, just as it continues for integration of public schools, institutions of higher learning appear intent on pursuing the goal of diversity. What is the situation today? What methods can improve diversity at our colleges and universities? A brief look at the situation for two universities with different approaches follows below, along with some ideas on improving the situation. Finally, some ideas concerning the use of alternate criteria and the outreach role of universities will be discussed.

Diversity in Higher Education

Faced with opposition from many quarters, institutions of higher learning are nonetheless determined to achieve increases in minority enrollment. This is the case at the University of Michigan, for example, where the admission policy is based on a 150-point system that includes points awarded for membership in a minority or socioeconomic disadvantaged group. The admission policy also awards points for students living in under-represented counties, for student athletes, and for those whose parents are University of Michigan alumni. It is important to point out that all students, regardless of ethnic background or minority grouping, must be academically qualified to compete at this highly selective institution, as well. Nevertheless, such a point system would seem to improve the opportunities for minorities without taking on the appearance of a quota system. The philosophy behind this admission policy, according to reporter Charise Pettit, recognizes that promising students should not be penalized for the weak secondary education they received [16].

Purdue University, another nationally recognized university with strong engineering and technical programs, does not consider race or minority grouping for applicants. Admission is based on class rank, grade point average, achievement test scores, and subject matter taken in preparation for higher education. Purdue University, however, actively recruits minorities, and the university-wide minority enrollment for the year 2001 – 2002 was

8.4%, compared with 13% minority enrollment at the University of Michigan. Minority enrollment in engineering at Purdue University is far less than that for the university overall, as is indicated by the information provided by the office of admissions of both universities and tabulated below. It is somewhat alarming that minority enrollment percentages, as indicated below, are actually decreasing at Purdue University, while the same numbers are increasing for the University of Michigan.

Minority Enrollment in Engineering

	University of Michigan	Purdue University
1993	11.5%	7.1%
1997	13.7%	6.1%
2002	13.6%	3.7%

Why is it that the University of Michigan is able to enroll a higher percentage of minorities under a more selective admissions policy than does Purdue University under a less selective policy? Certainly, one must think that the admission policy used by the University of Michigan and the related point system discussed earlier is one positive factor. Another may be simply related to the demographics of the state. According to the 2000 census, Blacks, American Indians, Hispanics, and Asians in Michigan were 19.9% of the total population; in Indiana, the same groups comprised 13.2% of the population.

An additional factor that impacts minority enrollment is clearly cost. In Aviation Flight, a technology program at Purdue University, the additional student costs for flight put the program out of the reach of most minority students, according to counselor Rose Bolyard, even those who are able to compete in the highly selective academic criteria used for admission decisions [15].

Alternate Criteria

The admission policy at the University of Michigan places a specific value on race, ethnic background, or membership in a lower socioeconomic group. Another approach that might provide similar selection benefits would examine the disadvantaged individual's performance on the basis of performance compared to their cohort. In *Beyond Affirmative Action*, author Robert Ibarra suggests that under such a philosophy, if a student scored 200 or more points above the average for **their group**, he or she could be identified as a "striver", and given special consideration for admission [13].

This same author [13] further argues that willingness and ability to overcome obstacles is a very significant predictor of success in higher education. Evaluation of students with respect to these personal qualities could also form the basis for alternative criteria. This has the potential to be of great benefit to minority groups in

comparison to the general population, given the socioeconomic status of these groups, in general.

Responding to the federal court rulings on the use of racial preference for admission, Texas state legislatures devised the 10% rule, whereby all high school seniors who graduate in the top 10% of their class may attend any University of Texas campus. Fred Hiatt writes that the philosophy behind this effort was to give students from socio economically disadvantaged schools an opportunity based on excellent performance [11]. The theory is based on evidence that top 10 percent students outperform other students with higher SAT scores. Enrollment statistics, however, do not reflect a major shift as a result of this legislation. Furthermore, such an initiative impacts minority groups significantly only where schools remain racially segregated and will obviously be limited in applications to larger universities that can sustain the enrollment mandated.

Additional criteria for selection that would increase enrollment success for some minority groups would emphasize the importance of a second language. Although this would not be of significant importance to African-Americans as a group, it would certainly raise the lot of other minority groups, i.e. Hispanics, in comparison with the white cohort. Generally speaking, according to Gary Orfield, fluency in a foreign language is considered to be a positive predictor of improved success in a global economy [14].

Improving College Readiness

While increasing the variety and types of criteria used for selection may improve opportunities for minority students, it is also important to address issues of college readiness for the same groups. If students can be better prepared, as a group they should be more successful in accessing a college education and successfully completing it. Some, however, will claim that “fixing” the secondary education problems will also repair the disproportionately low numbers of minorities in higher education. Such efforts generally emanate from the federal government, and have focused on testing and accountability as methods to insure success. While results of these efforts are unclear, at least a certain imperative exists for all schools under such plans. Unfortunately, the demographic problems continue, with Blacks and Hispanics concentrated in school systems that are generally under funded and without the tools to deliver quality education.

Upward Bound is a program that recognizes these inadequacies and attempts to make a difference. The United States Department of Education is the basis for the following information on this program [12]. Upward Bound is funded through the Higher Education Programs of the US Department of Education and provides fundamental support to participants in their preparation for college entrance. Participation in the program enables

students to increase their success in pre-college performance and ultimately in higher education pursuits. Upward Bound serves high school students from low-income families, high school students from families in which neither parent holds a bachelors degree, and low-income, first-generation military veterans who are preparing to enter postsecondary education. The goal of Upward Bound is to increase the rates at which participants enroll in and graduate from institutions of postsecondary education.

All Upward Bound projects are required to provide instruction in math, laboratory science, composition, literature, and foreign language. Various programs funded under Upward Bound may focus more attention on one area or the other; engineering and technology programs may choose to emphasize mathematics and science in and effort to improve preparation and competitive abilities in these areas.

Eligibility for Upward Bound

Upward Bound projects may be conducted by institutions of higher education, public or private not-for-profit agencies, a combination of institutions, agencies, and organizations, and in exceptional cases, secondary schools may apply.

Students must have completed the 8th grade, be between the ages of 13 and 19 (except veterans), and have a need for academic support in order to pursue a program of postsecondary education. All students must be either from low-income families or be potential first-generation college students. The program requires that two-thirds of the participants in a project must be both low-income and potential first-generation college students. The remaining one-third must be either low-income or potential first-generation college students. Students are selected based on recommendations from local educators, social workers, clergy, or other interested parties.

Two of the authors of this paper, Ronald Sterkenburg and David Stanley, participated in such a program during the summer of 2001. This particular effort targeted high school students in the East Chicago, Gary, Hammond, and Lake Station area of northern Indiana, and provided instruction in aviation-related subject matter for the participants, all of who were minority students.

In Table 1 on the following page, the funding and activity levels clearly indicate that this program is a broad-reaching and viable effort to impact on college readiness and preparation. Data collected by David Stanley and Ronald Sterkenburg indicates that these program have been very effective, with a high percentage of the students eventually enrolling in higher education, and of those tracked since 1996, 80% graduating from college [18]. Results of this and similar programs around the country indicate that higher education participation

and support of this type can have a significant impact on college readiness and success of the disadvantaged.

Table 1
FY 2002 Funding Information

Total funding for UB	\$264,189,513
Number of Awards	770
Number of Participants	56,324
Average Award	\$343,103
Average Number of Participants	73
Average Cost per Participant	\$4,691

Financial Support

Although court challenges have been made to scholarship programs that base eligibility on race or ethnicity, such funding still continues. Financial aid is available to minority students, but generally speaking, eligibility is still most often dependent upon academic qualification. The following is a short list of references that may assist minority students searching for financial aid.

1. Schlachter, Gail and Weber, R. David, *Financial Aid for Hispanic Americans 2001 – 2003*.
2. Schlachter, Gail and Weber, R. David, *Financial Aid for Native Americans 2001 – 2003*.
3. Schlachter, Gail and Weber, R. David, *Financial Aid for Asian-Americans 2001 – 2003*.
4. U.S. Department of Education, *Higher Education Opportunities for Minorities and Women – Annotated Selections*, 1996.
5. Eylene B. Wilson, *Money for College: A Guide to Financial Aid for African-American Students*, 1996.
6. William C. Young, *The Higher Education MoneyBook for Minorities and Women*, 1993.

Major scholarship funding for minorities continues to be available from large companies. Boeing Company, as reported by Marc Geller, recently announced a four-year educational partnership with Purdue University that includes \$1 million grant to provide support for minority students and women in engineering and business. The scholarships from these funds will be based on merit and financial need [9]. Unfortunately, just as a slow economy negatively impacts state support of higher education, it appears to have a similar affect on financial support available through industry.

Summary and Conclusions

Diversity is a difficult and controversial issue for higher education, and this is particularly true for engineering and technology programs. As minority population grows, the need for diversity efforts will become even more critically important, not only to the minorities directly affected, but

to society, as whole. The statistics don't lie, at least in this case. Higher education benefits not only those who obtain it, but all of society. Diversity has also been shown to increase the quality of the education process for all students, and this in itself should provide a mandate for universities and colleges to pursue the goal.

Nonetheless, court challenges will continue by those who are denied admission at universities where diversity is promoted. Institutions of higher learning will have no choice but to respond to decisions handed down, and pursue an acceptable approach that enables increased diversity without unfairly penalizing others.

Engineering and technology programs interested in increasing diversity must take action to improve the academic success rate of minority students. Efforts to improve the college readiness of minority students have shown some promise. The Upward Bound program, for instance, has had a large and beneficial impact on disadvantaged and minority students. Engineering and technology programs should actively support these programs. They should also examine selection criteria for ways to increase enrollment numbers of minority students, and provide opportunities to students with potential who might otherwise be eliminated by test scores and a secondary education the quality of which reflects their socio economic status.

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3. Chapa, Jorge and Lazaro, Vincent, “Hopwood in Texas: The Untimely End of Affirmative Action”, *Chilling Admissions*, 1998, pp. 56 - 59.
4. Crouse, James and Trusheim, Dale, *The Case Against the SAT*, 1998, pp. 89 – 95.
5. DeBoer, Larry, *The Outlook for the State Budget*”, Purdue University Faculty Senate meeting, January 27, 2003.
6. Digest of Education Statistics 2001, U.S. Department of Education, 2002, Table 381.
7. Edley, Christopher, “Foreword”, *Chilling Admissions*, 1998, pg. 62.
8. Fourier, Ron, (2003, January 16). *Bush: Michigan’s racial program’ unfair’*. Journal and Courier, A3.
9. Geller, Marc, (2003, January 26). *Boeing puts more behind minority efforts*, Journal and Courier, B1.
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