Tokunbo Ogunfunmi, Santa Clara University

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Abstract

Minority students in graduate school in engineering in the United States are quite few. The numbers are even fewer in small private schools. For example, statistics of black minority undergraduate students in electrical engineering are less than 5% in many small catholic private universities such as Santa Clara University. Given that not all of the undergraduates go on to graduate school in electrical engineering, the numbers are even fewer in graduate school, typically less than 1%.

The reality of low minority enrollment numbers in engineering and in electrical engineering in particular is unacceptable. Therefore, it is important to offer minority undergraduate and graduate students in engineering mentoring on the issues of retention, graduation and career advancement.

Recently, we began a program at our university to improve these statistics. This program is initially funded by a grant from the James Irvine Foundation. The preliminary results and the impact of our multi-faceted grant activities are presented in this paper.

Introduction

It is a well-known problem that the number of minority students in engineering in the United States is very small. In [1], we presented some of our findings and recommendations to rectify the situation especially regarding the number of minority graduate students in electrical engineering.

Over the last year some of the recommendations have been implemented, thanks to a grant from the James Irvine Foundation at Santa Clara University.

In this paper, we report on the impact of some of the recommendations. The focus of our paper is on the undergraduate student population and the impact of the recommendations on their initial experience at our institution.

We also give an overview of how our institution has developed and embraced many of the recommendations for implementation for engineering undergraduate minority students.

The paper is divided into five sections. In Section 2, we start with the motivation for this paper. Here, we also re-state the problem as we perceive it. In Section 3, we give some background about the school of engineering at Santa Clara University. We also present some of the institutional

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1 This work was supported by a grant from the James Irvine Foundation
support for our minority programs at SCU. In Section 4, we discuss some major objectives of our plan. In Section 5, we summarize some responses to survey questions about actual undergraduate student experiences. In Section 6, we enumerate new ideas and suggestions for mentoring undergraduate minority engineering students at the Santa Clara University on the issues of retention, graduation and career advancement. Finally, we draw some lessons from our experiences in the conclusions.

**Motivation**

The motivation for this paper is borne out of the disproportionate representation of minority blacks in engineering at all levels: undergraduate, graduate, faculty, industry, etc. [1]. This problem is well-documented [2] especially in academia. For instance, here are some statistics from the website: [http://www.facultyforthefuture.org](http://www.facultyforthefuture.org)

“The need for the focus on underrepresented groups is well documented. The representation of female faculty of all ethnicities in engineering and computer science in the US is extraordinarily low. The most recent data (CPST, 2001) indicate that female engineering faculty who have doctorate degrees employed at four-year colleges is at a level of 8.4%, an increase of 1.9% since 1997 (tenured and non-tenured, tenure track). The number of doctoral engineers employed as postsecondary faculty in two and four-year colleges is so small for Black, non-Hispanic, Hispanic and Native American women that there are blanks in the report indicating less than 500 people. For women, the data at the doctoral level has been on a slow but upward trend since 1998, from 810 degrees granted to 1,040 (17.3%) in 2003. African Americans and Hispanics received 1.6% (97) and 1.8% (107) Ph.D. degrees in engineering in 2003, respectively. This pool represents the potential source of college faculty. ....... The pool of doctoral degree recipients to draw on for a diverse faculty in computer science/engineering is extremely small (CPST, 2004).”

Are there potential candidates for minority faculty positions in engineering for the future? The reality of low minority enrollment numbers in electrical engineering undergraduate and graduate programs is unacceptable.

We have proposed some solutions that have been adopted and have been implemented by our institution. These proposals will be enumerated in Section 4.

**The Santa Clara University School of Engineering Programs**

The School of Engineering undergraduate program was started in 1912. Currently there are Departments of Electrical, Civil and Mechanical Engineering. The graduate program in engineering was started at about 1950 initially as an early morning and late evening professional classes for working engineers. It has since grown in size. Total current enrollment stands at about 600 students for the MSEE and 50 for the PhD program. About 30% of these students are full-time while the rest are full-time workers studying part-time towards their graduate degrees. The number of minority engineering students in undergraduate programs is less than 15% and in graduate programs is less than 5%.

For example, we offer a BS degree in Electrical Engineering with many possible emphasis areas including Networks, Analog Circuit Design, VLSI Design, Wireless Communications, Digital Signal
Processing, Image Processing, RF and Microwaves, Mechatronics and Control and Microelectronics and Nanotechnology.

The core of the Masters degree Electrical Engineering program is the following sets of courses: Four courses in Applied Mathematics (8 units), One course in Digital Systems (Logic Design or Synthesis) (2 units), One course in Electromagnetics (2 units), One course in Electronics (2 units), One course in Electric Modern Networks (2 units), One course in Control Systems (2 units) and One course in Applied Ethics (or Professional Practice) (2 units).

Out of a 45 units required for graduation, this MSEE core takes up 20 units. The original intent was to ensure a breadth of knowledge of electrical engineering at the master's level. With the remainder of 25 units, the student can take courses in emphasis areas like the ones mentioned above.

In the graduate curriculum, we also offer a small PhD program which requires 72 units of combined thesis and courses beyond the MSEE degree. There are only about total of 50 Ph.D. students.

The current institutional support for minority enrollment has improved. There are programs and centers that have been established to focus on these issues. For instance, the Multi-cultural Center (MCC) was established to provide a haven for minority students to be able to meet informally. They have also put up programs for these students. In addition, the institution’s activities in the Multi-cultural center has been funded in part by a major grant from the James Irvine Foundation. Now, the MCC has been put directly under the Provost Office for more visibility and oversight.

Also, there is an advising center (Drahmann Center) where all students can go for advising on any issue (academic, psychological, relational, etc) including tutoring, etc.

**Major Objectives**

The Problem is “Why are there so few of these students?” There are many possible answers to this question. However, our goal is to propose some solutions.

Our main objective is to implement a comprehensive program including some or all of the following best practices for advising, mentoring minority graduate electrical engineering students.

We plan to implement some of the ideas and goals from our paper [2]. Our objectives include new ways to enhance mentoring for recruitment, retention, graduation and career advancement for minority graduate students in engineering at Santa Clara University. We also propose ways to utilize the resources provided for research and bring distinction and academic excellence to Santa Clara University.

(1) Challenge your university to hire minority faculty members whenever possible to ensure minority students have a mentor to whom they can relate and will be a good advisor for them.

(2) Hold mandatory orientation meeting for new minority engineering students each semester/term.

(3) Organize a talk on campus by inviting a well-known successful minority engineer as speaker to share his/her experiences with our students (both graduate and undergraduates).
Attend the National Science Foundation (NSF)-funded program called “Presidential Award for Excellence in Science, Mathematics, and Engineering (PAESME)” for faculty. This is a two day workshop providing a forum on the needs, goals, methods, and best practices for mentoring engineering students interested in an academic career.

Ensure that our minority graduate students get the financial support to present the results of their thesis research at technical conferences. This will enhance Santa Clara’s academic excellence and help the students prepare for future careers as academics if they choose.

Make sure each graduate student in this program has a mentor (engineer) as well as a mentee who is an undergraduate student. Also, make sure each undergraduate student in this program has a mentor (engineer) as well as a mentee who is a local high school student. That way, they are not just receiving mentoring but giving out to positively influence lower-class engineering students.

Assign new minority students to the minority faculty as advisees (if at all possible).

Ensure minority students form study groups as well as encourage them to use the other academic resources available to the rest of the university students.

Get all minority graduate students involved in groups such as National Society of Black Engineers (NSBE) [1] which is a large country-wide organization (and local chapters) with lots of opportunities for networking, job search, career advancement, etc.

Write a follow-up paper to be submitted to the ASEE Conference for dissemination.

In addition. it is important to establish a pipeline from our BS to our graduate programs and from high schools to our BS programs. This pipeline will help us in recruiting. It is also important to offer all minority students in engineering mentoring on the issues of retention, graduation and career advancement.

To pursue these objectives, we received a grant from the James Irvine Foundation. After the first quarter, we held a survey of freshman mostly in Engineering to gauge their perception of the environment for minority students at our institution. We present the results next.

Survey of Minority Undergraduate Student Experiences at Santa Clara University

Below is the text of the survey sent out to the minority undergraduates (mostly freshmen). The four survey questions are:

1. How have you found the environment for you as a minority under-graduate student at the Santa Clara University? Please detail any interesting experiences.

2. Has the university been supportive (or not) of your academic pursuits? Describe.

3. What advice will you give to new minority Freshman under-graduate students admitted to the Santa Clara University in the future?

4. Have you joined any students groups and if yes, how has being (or not being) involved with them helped (or hindered) you in any way with respect to your studies at SCU.

Some of the responses to each question are collated below with quotes from the survey responses:
(1) How have you found the environment for you as a minority under-graduate student at the Santa Clara University? Please detail any interesting experiences.

- The environment at Santa Clara University has been very welcoming, despite me being a minority, under-graduate. Students, staff and all professors are very helpful and are always available during their office hours.
- The environment at Santa Clara University is very welcoming and warm to minority undergraduate students. As a member of the minority community at Santa Clara, I have felt comfortable in every aspect at the university. In all of the activities and experiences in which I have taken part in, the community has been welcoming, and I have not seen a difference in the way I am treated compared to all of the other students.
- The environment is socially accepting here although at times there isn’t enough cultural awareness. The community makes it easier to be a minority here but because there are such large amounts of kids from out of state, and out of the bay area it alters the socially accepting environment that’s been established. Although I have enjoyed my first quarter, there are still improvements that can be made.
- It’s great. Everyone is really friendly and the campus is easy to get around.
- Welcoming and supportive. Many events were held for minority students
- I have found that the environment as a minority undergraduate student at Santa Clara University to be welcoming and supportive. Daily campus life involves everyone being friendly to one another and there is always help when I seek it, it is not the cut throat type of environment that I have heard some other bigger colleges have.
- It has been a little bit weird because it is so rare to see another Latino on the campus. I haven’t been told any mean or derogatory things so far so it has been good. I have found a few Latinos and they are nice so it has been fun thus far.
- At first, it was intimidating for me to be at this school because I was so used to seeing many Asian people in my elementary, middle and high school. It took about a week or two for me to finally get settled into my environment. People overall are friendly, but it’s really a matter of when you want to open yourself to get others to know you. I still miss high school more, but at the moment I am pretty content with this school.
- I love the overall environment here at SCU! Everyone seems so friendly and has respect for their campus, peers, and staff.
- I never felt condemned for being a minority. Everybody is pretty welcoming and they want to get to know you which is a nice change from my last school where everyone basically minded their own business. The only thing I would say is that I don't live on campus and that's been hard because I feel I have to try and make friends with not just one person, but their entire group. What I mean is, a lot of people identify themselves with their dorm name and if you are not a part of one they kind of go "ooh". I don't it just feels like I have to try a little harder in that sense to make friends with groups of people.
- I feel less like a minority when I’m not at VSA or CSA or APSU, for some reason, which is nice.
- I’ve found it quite baffling at times when students ask particular questions about my traditions and/or background, but overall, I don’t think that I’ve been racially discriminated against or anything of that nature, so the environment is fine.
(2) Has the university been supportive (or not) of your academic pursuits? Describe.

- The university has been supportive of my academic pursuits. The teachers are extremely helpful and always available whenever needed for any kind of help.
- Yes, the university has been supportive of my pursuits to becoming a Doctor of Physical Therapy. Although I have not met with my Academic Advisor, I have met with the Academic Advisor of the Combined Sciences major, as I felt he would be the best source as to arranging my schedule. All of my professors have a passion for teaching, although at times I feel certain professors do not consider how they are teaching. I feel that some teachers do not understand that their style of teaching and pace do not correlate and do not create reasonable educational environments. Some of my professors, however, understand this and take this into account and make the extra effort to help their students.
- In all subjects except one I have been supported. I believe there was some sort of ethnic where I was just misunderstood. My teacher was also a minority of a different ethnicity, whom didn’t speak English well. This made academic communication difficult because no matter how respectfully I approached her she became defensive and quickly hostile. I believe my grade was altered negatively because I didn’t know how to make any of my work better without personally conversing with her. However she would get frustrated in these talks.
- Yes, the professors always ask you what your majoring in and they give you advice.
- Yes, I receive e-mails regarding minority scholarships and programs. On a whole SCU offers its students a lot of services which I have also taken advantage of, such as free private tutoring, peer education sessions and there are several quiet study spaces provided.
- The university has been supportive of my academic pursuits because I’m trying to pursue a double major with mechanical engineering and business finance and the advisors from both the Drahmann center and my personal academic advisor have been extremely helpful in helping me plan out my classes.
- The school has been very supportive of my academic pursuits. When I wasn’t sure on what classes to take and if I would be able to double minor I just had to e-mail my advisor and she directed me to someone that could help me.
- The university has been helpful in my academic pursuits. Professors overall are very friendly, and they really encourage you to ask questions and participate in class. It shows that they really care about their students and whether they understand the material or not.
- Yes! I’m constantly updated on internships and there are plenty of counselors that are more than happy to work with you. As a Junior (transfer student), I have already decided that I wanted to work with kids in either psychology or Liberal Studies and the career center confirmed that with their personality career test on myroads.com
- Yes; I feel that the university is being supportive of academics, especially with setting up people to academic advisers, etc.
- I feel like the university has been supportive of my academic pursuits.

(3) What advice will you give to new minority Freshman under-graduate students admitted to the Santa Clara University in the future?

- I would advice future minority freshman under-graduate students to keep an open mind, work hard and enjoy their freshman year. I would also advice them to be involved in many
activities offered at Santa Clara University and join as many student organizations to meet new people and build lasting friendships

- My advice for incoming Freshman at Santa Clara University is to make sure to become involved in every way possible. It is great to put yourself out there and make as many friends and relationships as possible. Although you are closest to those you live with, it is great to meet new and other people who live at different residence halls. I feel that I put a great deal of effort into meeting new people and it definitely has paid off. I have many friends now and feel that it is a great opportunity. Also, make as many athletic events as possible, as they bring a great atmosphere to the campus.

- I would suggest them to be understanding and patient with the surrounding communities and I would list all the people they could talk to for further support and guidance.

- Don’t think that you’re the only minority because no one treats you like your different. Everyone is real nice and you can always find someone who shares your culture.

- I will strengthen the minority population.

- I would say don’t be afraid to ask any questions because everyone here from the faculty to the students is willing to help in whatever way they can or point you towards someone who can help you with your questions.

- I would tell all the freshman to have fun and don’t take too many units on the first semester because it is a big adjustment period.

- Do not fall behind in classes. Once you do, it’s difficult to catch up. Also, a good way to make friends is to attend social events or participate in clubs or sports. That way, if you’re ever bored, you have someone to hang out with. Finally, the first week of college seems lonely, but after that, you pretty much get used to it.

- Well, I do not know because I came in as a transfer and I did not live on campus, so I guess the biggest thing is time management. Make sure you can balance both school and a social life because too much of either is not a good thing.

- Have fun and don’t stress out. SCU has you covered. =)

- The advice I’d give is to be prepared for anything. Have a tough shell and stay focused.

(4) Have you joined any students groups and if yes, how has being (or not being) involved with them helped (or hindered) you in any way with respect to your studies at SCU.

- I have joined a South Asian organization called Intandesh. It is part of the MCC. It has helped me meet new people and some really great fellow upperclassmen students.

- I have joined Ruff Riders, as well playing on an athletic team at Santa Clara. I also attempted to join other various activates and groups, yet was not accepted based on qualifications, but I am very happy with where I am currently. It is a great way to meet new people and become one within the Santa Clara University community.

- I have joined the club rugby team. I was also briefly a member of the media club that makes t.v. programs and such. I played intramural rugby and I am still an active member in Igwe but being a civil engineer it’s hard at times to balance my time. As a student you just need to recognize that and try and find a medium I believe at one point my grades weren’t as good as they could have been but when I devoted more time to my studies.

- I haven’t really joined any student groups except for the LEAD program which is extremely helpful for any incoming freshman.
• I have joined several students groups and have enjoyed them. It’s been a good way to meet people and feel more comfortable within the university.

• I have joined a lot of student groups and found that being involved has helped me with respect to my studies at SCU because the MCC provides a safe and fun place to hang out and allow me to take a break from studies and relax. Also, in every student group that I have been a part of, I can ask the upper class men for advice and they gladly give it to me.

• I play intramural Tennis and I’m also in the anime club. Intramural tennis is very low key (playing only once a week) so it really does not hinder my studies. Anime club is also very chill. You watch anime episodes for like three hours. People there don’t really care if you come or not, but you know it’s nice to go there just to get away from the academics.

• Apart from school, I joined Core, which is a Christian club here on campus. I did not get as far as being “on staff” or anything, I simply go every Tuesday. Even then, there were certain days I couldn’t go because I had a midterm or something the next day and it was fine; everyone understands that there are more important things to do. I like it a lot because you get to know a lot of great people who really love you for you are…they’re not judgmental.

• Since I’m working and commuting, it’s hard to find time between classes and things to do homework, so when I joined certain clubs, I found that I couldn’t be as active as I wanted to be in them because I just didn’t have time.

• Yes I have joined two student groups. Being involved has helped me manage my time and make sure that I have my studies out of the way before I pursue my other activities.

One of the survey respondents actually was appreciative of the survey. Here are the comments:

• Thank you for these surveys. I'm glad you have taken the time to "check-in" with the students because then possible changes can be made. ..........I wanted to let you know that I'm not a freshman. It's true that this is my first quarter here at SCU but I transferred from another college and I am a Junior. Just wanted to make sure that was clear. Again I really do appreciate the surveys, Thank you!

Doing this survey ahg given us some feedback in the effectiveness of our programs for minority engineering students at our institution.

Students excel when they are in a welcoming environment and when they have the institutional support they need to be their best. Our survey shows we have tried to provide that.

The grant has provided funding to attend the two day workshop which provides a forum on the needs, goals, methods, and best practices for mentoring engineering students interested in an academic career and young faculty beginning such a career. This program called “Presidential Award for Excellence in Science, Mathematics, and Engineering (PAESME)” [3] is funded by the The National Science Foundation (NSF).

This will no doubt enhance the minority engineering programs we offer.
Conclusions

In this paper, we have followed up on our previous paper which identified a major problem of recruiting, retaining, advising and mentoring black minority students for success in graduate as well as undergraduate engineering programs.

We started by giving the motivation for this paper where we re-stated the problem of low percentages of minority engineers. Then, we gave some background about the school of engineering at the Santa Clara University. We also presented some of the institutional support for our minority programs at SCU. In Section 4, we discussed some major objectives of our plan.

Later we focused on the responses to survey questions about actual undergraduate student experiences. This enabled us to learn some new things about how our students perceive the environment at our school.

Finally, we conclude that our students will succeed in the areas of retention, graduation and career advancement in engineering if we provide a welcoming environment and give them the institutional support they need to be their best.

Bibliography

