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Diversity and the Duke BME PhD Program: Then, Now and Moving Forward

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Parable of the Star Fish

One morning a man was walking on a nearly deserted beach when he came upon a boy surrounded by thousands of starfish. As eagerly as he could, the youngster was picking them up and throwing them back into the ocean. Puzzled, the man asked, “Little boy, what are you doing?” The man continued, “Son, there are thousands of starfish and only one of you. What difference can you make?” Holding a starfish in his hand, the boy turned to the man, and gently tossing the starfish into the water he said, “Made a difference to that one!”

(Source unknown)

Experience tells me that there are four stages of institutional change: opposition, indifference, accommodation, and incorporation. We see this over and over again in the evolution of companies, universities, associations and professional societies. I’ve been around long enough to recall when opposition to minority participation was the norm; however, American universities have moved into overall accommodation of diversity with pockets of open incorporation (varsity sports), a healthy dose of indifference (not my problem), and stubborn elements of opposition (the individual rights movement). By being willing to strike a colorblind posture, universities are willing to accommodate difference as long as the essential characteristics of this difference are largely indistinguishable from the majority; i.e. the doors are opened but the overall enterprise remains unaltered [1]. Apropos to the starfish metaphor, accommodation of underrepresented minorities is currently accomplished incrementally one relationship at a time. Moving to incorporation, however, means that the enterprise must change. In this context, I examine where Duke BME was when I got engaged in diversity activities, where we are now, and how we might move forward.

Then

When I received tenure at Duke in the mid-1990s I looked around me and saw that there was no more than a handful of African-American doctoral students in all of the engineering, math and physical science graduate programs at Duke University. Prior to 1995, the School of Engineering at Duke had granted only one Ph.D. to an African or African-American. My own Department of Biomedical Engineering (BME), a nationally top-ranked program, had never granted a Ph.D. to an African-American in 30 years of existence. While there was no open opposition to minorities, it was clear that indifference abounded. In 1996 I embarked on personal mission motivated primarily by my own sense that Duke BME had the capacity to become a more inclusive and diverse place. It just lacked the will and the knowledge to see it through.

At the outset of this journey I made a few strategic decisions that narrowed the scope of my efforts to an achievable list. First, I decided to focus my attention on graduate education and not attend to the equally compelling issues found at the undergraduate and K-12 levels.

There are a number of excellent resources that discuss these elements of the pipeline [2,3]. Second, I advocated strongly for maintaining Duke BME's tradition of individual faculty recruiting individual students directly into their research group (although I now have second thoughts). This was a critical foundation because it not only allowed me to independently recruit URM students, I was also able to present URM recruits to specific faculty who I knew would take the responsibility seriously. Third, I decided that the first students for whom I would advocate must bring with them traditional indicators of success, such as solid GRE scores (>1250 V+Q); good grades (>3.5 GPA) in engineering, math and/or physical science classes; significant undergraduate research experience (>1 academic semester or summer internship); and/or an undergraduate degree from a top-notch program. Fourth, I knew that I had to be among the first to mentor URM students and that these students had to be successful before I could convince others to join me. Fifth, I had to have access to discretionary funds that I could tap to the support URM student tuition, stipend and fees.

Rather than using tenure to simply optimize my scholarly opportunities (the preferred path), I also felt that tenure gave me license to try and make my institution a better place. The following describes a straightforward attempt to address one of the most persistent and vexing problems in graduate education: the recruitment and retention of underrepresented minorities (URM) in science, technology, engineering and math (STEM). In the end there was nothing mysterious about what occurred here. The project was neither easy nor impossibly complex. Nor was it done alone. It succeeded through preparation, coordination of resources, alignment with the departmental culture, persistence, and the steadfast support of others. That said championing diversity is not for the faint of heart and there are better causes to pursue if your primary goal is professional advancement.

Preparation

Before I could even begin to imagine what being a black BME student at Duke might be like I felt it important to immerse myself in a place where I was clearly the different person in the room. In 1996–97 I took the professionally risky step of taking sabbatical leave at North Carolina Central University, a Historically Black University that was a mere four miles from the Duke campus. At NCCU I committed myself to studying the topic of minority STEM education, focusing of course on engineering. I published three papers in the Journal of Engineering Education on minority undergraduate and graduate students, and on “survival skills” for tenure track faculty in academic science [4–6]. Through this exercise I decided that successful and sustainable mentoring of URM graduate students in STEM could occur in Duke BME if the following points were understood from the outset.

Student recruitment is relatively straightforward.

Student retention is comparatively difficult.

Students must be apprised of expectations and treated uniformly from the start.

Independence must be instilled, not simply expected.

Open and honest discourse between the student and advisor is essential.

Talent is just a prerequisite for success; the rest is opportunity, luck and hard work.

Administrative support and access to fellowships are essential, but success or failure occurs at the relationship level.

STEM faculty will enthusiastically mentor any graduate student who is perceived as someone who will help them accomplish their research goals.

Resistance to student diversification is greatest when you recruit by consensus and consume funds from the general pool of resources.

Interestingly, none of the above points are intrinsically specific to URM students; they are merely good practice.

Coordination of resources

Upon returning to Duke, I was appointed Director of a NIH biotechnology training grant that supports predoctoral fellows during the first years of their graduate training. The training grant directorship was essential because it mandated that a concerted effort in recruiting and retaining URM students, or run risk the possibility of losing the funding. Soon thereafter, BME chair Roger Barr appointed me Director of Graduate Studies (DGS) in BME. Simultaneously holding the positions of DGS in BME and of training grant director from 1999 to 2003, afforded me the authority, resources and justification necessary to put my sabbatical into practice.

The central resource was of course the graduate school. Each graduate program at Duke receives a budget (based primarily on program size) from the Graduate School to support student tuition, stipends and fees that are also supplemented by research funds, fellowships and training grants. Funds from the graduate school were both substantial and largely discretionary because the BME PhD Program was and is the largest at Duke University, well funded, successful in garnering external fellowships, and had two NIH training grants to support graduate students. The Graduate School also offers two-year fellowships from the Duke Endowment to the most highly qualified URM applicants.

This mix of the Graduate School, BME, and directorship of the training grant provided critical resources and opportunities that I could manage. Specifically:

Many URM students applying to the BME graduate program fit the criteria for intramural Duke Endowment and training grant fellowships, and for extramural fellowships from the NSF and DOD.

As Director of Graduate Studies in BME and the Director of the biotechnology training grant I had multiple tangible resources at my disposal (student tuition, stipend and fees) that I could allocate, including discretionary Graduate Program funds to support students after fellowships had run their course if necessary.

BME recruits graduate students directly into research groups rather than requiring them to rotate before identifying a research advisor. This meant that the URM students have a “home” from Day One, and that I could steer URM applicants to faculty who would mentor them well.

Alignment with the departmental culture

Doctoral programs in STEM have remained difficult for URM to penetrate because STEM graduate students are the prime vehicle by which faculty accomplish their research agenda. This has led to a “risk-averse” dependence of faculty on student success that does not exist in medicine, law or business. It is also not the case in the humanities, summer research programs, or with undergraduate education. This expectation is both STEM’s greatest strength when it works, and its greatest barrier to success when it fails. Overcoming this perceptual barrier is the most challenging aspect of increasing the presence of URM PhD students.

I realized that the faculty and departmental “comfort zone” had to be addressed so that “URM” was no longer a defining characteristic; rather, it needed to become a nuance within a larger context. To be successful within the Duke BME framework, this transition had to be advocated by a faculty member who had:

Successful and productive URM students in his or her own lab;
 A vigorous research profile;
 The respect of other BME faculty;
 Control over resources for supporting URM students; and
 A department chair and dean that were supportive of change.

Proceeding with anything less would have been unsuccessful from the outset.

Working closely with Dr. Jacqueline Looney, Senior Associate Dean of Graduate Student Affairs in the Graduate School, I used a combination of graduate school, Duke Endowment, and NIH training grant funds to recruit a crucial nucleus of two URM graduate students in 1998 and 1999 – Drs. Helawe Betre and Lori Norton (Figure 1). Professor Lori Setton and I mentored Helawe and Lori directly in our labs. These students enthusiastically embraced the opportunity and were clearly up to the task; however, I am deeply grateful that all of the students involved with Helawe and Lori in the classroom or in the lab were open, thoughtful and generous. The warm and welcoming climate provided by their fellow students was an absolutely critical element in Helawe's and Lori's success (as it would have been for any student).

Next, I broadened the effort by recruiting a second wave of students and began encouraging other BME faculty who embodied this vision to take URM into their research groups. By the end of my term as DGS in BME in 2003 there were eight URM graduate students in BME working in the research groups of seven different BME faculty members. Each URM student also fit well within the overall departmental profile for academic preparation and talent.

Steadfast support of others

This project would not have been successful without early support from BME Chairs Roger Barr, Mort Friedman and George Truskey, Engineering Dean Earl Dowell, Graduate School Dean Lewis Siegel and Jo Rea Wright, Associate Dean of Graduate Student Affairs Jacqueline Looney, and (eventually) Provost John Strohbehn (Figure 2). I also had the unflinching support of the University President Nan Keohane and the BTE Steering Committee. This gave me the freedom to research the topic thoroughly, to implement what I had learned at NCCU, to venture outside of established recruitment norms, and to allocate resources to where they would make a difference. I also had a group of supportive graduate students in my own lab and within BME who believed in what I was doing and who welcomed URM students. Finally, I had access to BME faculty who could be counted on to recruit URM students into their research group if asked, and who would mentor them with enthusiasm (Figures 3).

Impressions and recommendations

The following is my minimum set of “musts” for recruiting and retaining URM graduate students.

University administrators must provide tangible resources that support URM student stipends, tuition and fees, and voice unambiguous support for diversifying the graduate student pool.

Graduate program directors must be the primary advocate for mentoring URM students in the department, and must be selected from those who the faculty holds in high professional regard.

Directors of graduate programs must have the flexibility to allocate the resources needed to recruit a “nucleus” of URM students, and these early students must be academically in alignment with the BME graduate student cohort as a whole.

The first faculty mentors of URM students must be carefully selected by the graduate program directors for their embodiment of the vision for diversifying the student body, and for the high regard that other faculty members hold them. It is best if the program director is among the first to mentor URM students.

Starting a “minority recruitment office” staffed by someone who is not involved in the research enterprise, or sending delegates to professional URM gatherings, can have great value in promoting diversity; however, it may be of little use if these efforts are undermined by a lack of meaningful faculty-student mentoring relationships. Eventually it boils down to individual faculty committing to individual students and visa versa. If ever there was a benchmark, this is it.

It is an absolute certainty that faculty who are recruiting students, and the very students that they are attempting to recruit, will make decisions that are in their best interests. Consequently, a faculty member may decide that it is not worth the potential cost in time and productivity to mentor a student who is seen as a “project”. The lack URM recruitment success fostered by this attitude is often dismissed as “we can find only few minority students worth recruiting” or as “we can recruit them but they wont come anyway.” This is probably a self-fulfilling prophecy because the best and brightest minority students will enroll in top programs where their presence is perceived as a positive contribution. Addressing this interplay honestly and directly in the resource-limited world of academic research is central to ameliorating stigmas attached to URM students.

I know that I am challenging the opinions of a number of thoughtful and influential people when I stress the importance of nurturing a nucleus of strong students when building a URM student presence. However, top BME graduate programs fill their student bodies with the very best students from the very best undergraduate programs. Making an exception to this gold standard by bringing students into an environment that is not committed to their success or is suspect of their qualifications should be pursued with great caution. Failure to thrive serves no one well.

Now

By 2000, Duke BME awarded its third Ph.D. to a Hispanic-American, its first to an African-American in 2004, and its first to a Native-American in 2011. In 2013, the current cohort of eleven African-, Native- and Hispanic-American Biomedical Engineering doctoral students comprises more than half of the total URM engineering PhD students, and the second highest number of underrepresented minority (URM) doctoral students in the 24 STEM PhD programs at Duke (one behind psychology and tied with sociology). A full listing of Duke’s Masters and PhD recruitment and enrollment statistics broken down by program, gender, race/ethnicity and citizenship, is easily found on the web at <http://www.gradschool.duke.edu/About/statistics.htm>.

Table 1 tracks the full enrollment of URM BME PhD students at Duke from 1999–00 to present. I am pleased to say that what began as a personal mission is now nominally an on-going aspect of our graduate program. However, these data reveal both encouraging and discouraging trends where Hispanic recruitment is clearly ascendant, whereas African American and American Indian recruitment is diminishing. Interestingly, other PhD programs at Duke (and I suspect other peer programs) are witnessing these same trends.

Essential reading for anybody interested in diversity in engineering education is “Engineering by the Numbers” published by the American Society for Engineering Education [7]. Over the last decade the percentage of Bachelors, Masters, and Doctoral degrees that have gone to African- and Hispanic-Americans has stagnated in the low to mid single digits nation-wide. That said, the URM presence in virtually all BME graduate programs is now commonplace.

Most BME programs would say today that they do most of the above in one form or another; however, it is what these programs do that matters, not what they say. I submit that transparency, or a lack thereof, is a good indication of programmatic intent. Recently I made personal appeals to peer graduate programs for their minority application and admission statistics. While a few programs willingly offered statistical data, most declined to share these data with me. It is even more unusual to follow Duke’s example of placing graduate recruitment and retention data on the web for all to see. This suggests that many graduate programs are still queasy about diversity.

A URM presence is still built one relationship at a time. Until things change significantly, this means majority faculty stepping forward to enthusiastically mentor minority students, and minority students being openly receptive to the mentorship offered by these faculty. If you can recruit students directly into your lab and want to make a difference, then get busy and start recruiting! Give this student a “home” the day that he or she steps on campus. It is also important to let this student and the other members of your group know that you are going to make this work. If however you are in a program that admits students by committee and you want to make a difference, then get yourself on this committee! Once in place, convince the committee to earmark the funds that gives you the latitude to go out and personally recruit a URM student.

In either recruitment system it is preferable to commit funds (e.g. training grant slots or fellowships) that gives the URM at least two years of funding prior to going onto a research grant. The NIH and NSF also offer multiple year supplements to existing research grants that can cover student stipend, travel and supplies.

<http://grants.nih.gov/grants/guide/pa-files/PA-12-149.html>

<http://www.nsf.gov/pubs/2012/nsf12007/nsf12007.jsp>

The Duke BME faculty regularly take advantage of these supplemental funding opportunities.

Moving forward

Unfortunately, recruiting small numbers of minority students and meting them out essentially one student per lab is self-limiting. This is why almost all BME graduate programs are stuck firmly in accommodation. The only non-HBCU BME programs that I know of that even approach URM incorporation are City College of New York and Georgia Tech. In order to expand the cohort of minority students and move the rest of us closer to incorporation means that we need to change. In my opinion, the keys to transforming the Academy will be confronting the following issues both honestly and thoughtfully.

Diversity was never part of higher education’s DNA

The roots of the Academy are a homogeneous and exclusive group of scholars and students propagating homogeneous and exclusive thought [8]. At best the diversification of higher education has been a post-transcriptional modification that resulted from a slow change in the composition of the academic leadership. The only way that this transformation will

continue is by continuing to bring more women and minorities into decision-making positions. And this can only be addressed if women and minorities seek and are successful in academic careers.

The problems in K-12 are not an excuse for doing nothing in higher education

Race and ethnicity and the problems in U.S. K-12 education can be likened to the skins on an onion: peeling off one layer only reveals the next [9]. Faculty and administrators that surrender to the enormity of the overall problem allows normally open-minded people to feel better about declining the opportunity to recruit minority students; i.e. the poor risk to benefit ratio does not justify the negligible impact. This is nonsense. At the very least the BME community should focus on developing the capacity to take care of the people who are knocking on our doors today. This will require that academic leaders make faculty participation in diversity a professionally legitimate endeavor and part parcel of the departmental discussion.

Use the Masters degree to “hit the reset button”

Many URM engineering students experience difficulties as freshman and sophomores, but if they persist in engineering they often do well academically as juniors and seniors. Unfortunately, the poor grades received during their first two years eliminate many URM from consideration by faculty for doing independent research, and ultimately from consideration by PhD programs. To bridge this gap we have begun encouraging minority students to consider undergraduate research during the regular semester, and by offering admission to thesis Master programs in engineering to students who had academic problems as underclassmen but who persisted and turned it around as upperclassmen. We provide hourly compensation for working in the lab and for the Masters students we provide a tuition scholarship. The majority of these students have performed well, essentially reversing their academic record, and many have moved on to medical school or graduate school.

Make mentoring part of the promotion and tenure rubric

Traditionally, academics is considered a three-legged stool comprised of research, teaching and service. However, effective mentoring has been shown time and time again as the most effective instrument in encouraging students to consider research careers. Mentoring is also distinctly different than teaching or service, and good mentoring is frankly (and unfortunately) not necessarily correlated to faculty research productivity. The only way to raise appreciation of mentoring by the faculty that do not gravitate to it naturally is to make it a formal part of the review and assessment process. This accomplishes the goal of requiring faculty to give thought to their mentoring contribution and places the mentoring discussion squarely front and center.

Broaden the effort

We could all learn from the work at the University of Michigan that is proactively diversifying its STEM faculty. Michigan established the “STRIDE” committee that is a diverse group of senior and well-informed STEM faculty who “advise individuals and departments on hiring practices aimed at increasing both the diversity and excellence of the faculty through presentations, detailed and targeted advice, and/or focused discussions as needed.” This committee has published a handbook that integrates and summarizes the recruitment and hiring practices that have been identified as effective, practical, and fair for increasing the number of women and minorities in STEM faculty positions (<http://www.advance.rackham.umich.edu/handbook.pdf>). STRIDE also offers the “Workshop on Faculty Recruitment for Diversity and Excellence” for search committee members and other faculty (<http://sitemaker.umich.edu/advance/stride>). While STRIDE provides a soup to nuts

description of the process, a key aspect is to establish search committees with broadened expertise and disciplinary targets to increase the pool of eligible women and minority candidates.

The Michigan College of Engineering has also established an annual future faculty development workshop called “NextProf” to encourage talented women and underrepresented minorities to consider careers in academia (<http://www.nextprof2013.engin.umich.edu>). The workshop is limited to ~50 “high potential” PhD students and postdocs provides from across the country and provides an all expenses paid presentation and discussion of strategies and best practices for strengthening the participant’s ability to pursue an academic career.

Concluding comments

Exactly how success in growing diversity is accomplished may vary, but the essential element at the PhD level is creating real faculty-student and peer relationships that are positive examples of the vision that diversity and excellence can and should coexist. This is still a “seeing is believing” proposition and it remains the prerogative of the individual students and faculty to decide whether or not they want to get on board. A number of people, if shown the way, will follow. This is where you come in.

Our current Dean of Engineering, Tom Katsouleas, has recognized my commitment and placed me in an administrative post where I am free to provide support and encouragement to other the engineering departments to recruit URM graduate students. The number of URM students that are studying for the Masters and Doctorate in the Pratt School is now starting to grow in programs outside of BME. Our dean has also made mentoring a line item in the Scholarly Activity Report completed annually by all faculty, and has begun requiring bias training for all approved search committees as well as asking one member of the committee to be a diversity designate.

Finally, I clearly did not address the issue of women in engineering, which is also covered in “Engineering by the Numbers” [7]. While the number of women BME faculty still lag significantly behind men, I no longer see this as an issue of preparation, expectations, or an inadequate talent pool (all of which are still issues with URM). In my opinion women are well on their way to incorporation, albeit more slowly than desired. This is frustrating because 75 of 185 PhD students in BME are women (41%), but only five of 29 faculty members with primary appointments in BME are women (17%). An important goal of Duke BME should be to encourage more of these women students to consider academic careers through more accessible role models, greater networking, and encouraging smart career/lifestyle choices. I hope to encourage my many talented and successful female colleagues to take up this cause.

Acknowledgments

If you decide to be an advocate for diversity do not expect everybody to applaud your efforts or to get on board; however several people will step forward to support you. I extend my most sincere appreciation to the many people who encouraged me to embark on this journey, and the many people who supported me along the way, many of whom are pictured in Figures 2 and 3. Everybody that I encountered at NCCU was wonderfully welcoming and forthcoming, particularly the Department of Chemistry that hosted me. I also appreciate the support of Warren Jones of NIGMS, who saw the impact that my efforts had on my biotechnology training grant in Biomolecular and Tissue Engineering (BTE, GM8555), and Martha Absher, the Associate Dean for Education and Outreach, who has been my compatriot in diversity at Duke. Most of all I thank the BTE PhD students, particularly the URM students (Martin Moebus, Warren Marcus, Helawe Betre, Lori Norton, Isabel Cardenas-Navia, Heather Prichard, Charles Anamelechi, Nelita Trotman-Elliott, Ned Will Garrigues, Luke McSpadden, Timothy Mwangi, Chris Rowland, Suzana Vallejo-Heligon, Nichole Verdone, Cristina Fernandez, Brittany Davis, and Jennifer Gamboa) and the other

hundred or so BTE non-minority who made the program a welcoming place. Finally I thank Barbara Nsiah of Duke University for her thoughtful comments on the manuscript.

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Figure 1. Professor William Reichert flanked by Drs. Lori Norton and Helawe Betre with Drs. Jeff Lamack and Jason Smith in the background. The occasion was the May 2006 Hooding Ceremony at Duke University.

Roger Barr

Mort Freidman

George Truskey

Earl Dowell

Lew Siegel

Jo Rea Wright

Jackie Looney

John Strohbehn

Figure 2.
Supportive chairs and administrators.

Lori Setton

Farsh Guilak

Fan Yuan

Bruce Klitzman

Joe Izatt

Pat Wolf

Warren Grill

Nenad Bursac

Kam Leong

Craig Henriquez

Mark Dewhirst

Gabriel Lopez

Figure 3.
Supportive BME faculty colleagues.

Table 1

Full Enrollment of URM PhD Students in Duke BME

	AA	HIS	AI	total URM
1999-00	2	1	0	3
2000-01	3	1	0	4
2001-02	3	1	0	4
2002-03	5	2	1	8
2003-04	6	2	1	9
2004-05	8	2	3	13
2005-06	8	3	3	14
2006-07	6	3	2	11
2007-08	6	4	3	13
2008-09	4	3	2	9
2009-10	5	6	2	13
2010-11	4	10	2	16
2011-12	3	9	1	13
2012-13	1	9	1	11

AA: African American, HIS: Hispanic American, AI: American Indian