

# Expanding the Engineering Education Infrastructure of an Island Territory University

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**Abstract** — *The University of the Virgin Islands (UVI) is a leading institution for higher learning in the Caribbean and the only higher education institution in the Territory of the U.S. Virgin Islands. It is accredited by the Middle States Commission on Higher Education, has an enrollment of 2,500 students, and a faculty of 110. It is the only designated American Historically Black College and University (HBCU) outside of the continental United States. It is more than 75% female and has begun a Male Initiative to recruit, support, and retain more male students. According to UVI President Dr. David Hall, "We have a crisis in the Virgin Islands in regards to young men". This is a problem across the United States as it has been reported that Black males are underrepresented in both HBCU's as well as public flagship institutions. In order for UVI to live up to its tagline of "Specializing in Futures," it must seek alliances with other institutions that can expand the opportunities it can offer to their students and to attract more participation from others. One such partnership is with the South East Alliance for Graduate Education and the Professoriate Program, an Alliance that includes the University of Florida (UF), the University of South Carolina (USC), and Clemson University (CU). All three of these institutions have strong engineering programs, one of the areas not currently available to UVI students on their campus. Engineering was the most desired major of VI high school seniors in the class of 2008 and one that has traditionally been attractive to male students. Adding an engineering component to their curriculum would not only enhance the opportunities for existing students, but may also help them reduce the gender disparity that the Male Initiative Program seeks to address. Although separated by over 1000 miles, these four schools are using a combination of on-site and distance learning to significantly enhance the engineering educational infrastructure of a geographically isolated institution. This alliance can serve as model for other institutions as they partner with research institutions at a distance to enhance their engineering curricula.*

**Index Terms** — *Dual degree programs, engineering enrollment, diversity, transfer transitions*

## INTRODUCTION

Engineering schools across the country have for years grappled with African American undergraduate enrollment and degrees earned. As early as 1971, Purdue University students saw a need for programming for African American engineering students and started The National Society of Black Engineers as a local group to improve both the recruitment and retention of black engineering students [1]. It has now grown to 250 University student chapters. In 1992, The National Science Foundation (NSF) sought to address these issues by establishing a program now called the Louis B. Stokes Alliances for Minority Participation in Science, Technology, Engineering, and Mathematics (LSAMP). This program is aimed at increasing the quality and quantity of students successfully completing science, technology, engineering and mathematics (STEM) baccalaureate degree programs and increasing the number of students who continue to graduate school. In the first 14 years of the program, more than 225,000 bachelor's degrees were awarded to minorities participating in LSAMP. More than 200,000 students are now enrolled, graduating 25,000 per year [2]. In spite of these efforts, the current level of participation in engineering by African Americans remains low. Engineering minority enrollments grew from 20,833 to 25,920 between 1990-1993, peaked in 2001 at 27,442, and since then has steadily dropped to 21,898 in 2007, approaching the level of 1990 [3]. The steady decline between 2001 and 2007 was at a time when overall enrollments increased (between 2001 and 2003), and then declined to a level well above the 1990

enrollment. In 1995 African Americans earned 3.3% of engineering bachelors' degrees and in 2005 this dropped to 2.5% [4].

In addition to the low participation of African Americans in engineering, there is another factor that is impacting this group. African American females now have higher undergraduate enrollments representing 63% of the total African American enrollment [5] and 69% of Bachelor's degrees [6], although men still earn a higher number of engineering degrees [5].

Concurrent with these changes, universities across the country have been challenged to increase the diversity of their student body. The University of Florida (UF) is the flagship institution in Florida. UF's President Dr. Bernie Machen has established a Council on Diversity to make campus-wide recommendations to ensure that UF represents the community in which it resides. UF currently ranks 5th in production of African American Bachelor's degrees, behind Georgia Tech and three Historically Black Universities and Colleges (HBCUs), but is committed to improving even more [7]. Clemson University (CU) recently hired a Chief Diversity Office to meet its goal of achieving a diverse community that welcomes all people. At the University of South Carolina (USC), In January 2009, President Pastides appointed a Diversity Task Force to develop a USC System Strategic Plan for Diversity that will serve as a foundation for fostering a diverse and vibrant academic environment by establishing an overarching strategy for increasing, celebrating and incorporating diversity into all aspects of the university. In 2005, these three institutions formed the South East Alliance for Graduate Education and the Professoriate (SEAGEP), one of a national network of NSF funded centers that have the long term goal of increasing the diversity of the Nations' science, engineering, and mathematics faculty.

In addition to research extensive intuitions such as UF, CU, and USC, HBCU's are a critical part of the higher education system of this country. These institutions opened their doors to educate African Americans when they were the only avenue open for these students to receive a college degree [9]. HBCUs accounted for only 4% of all 4-year U.S. colleges and universities, but awarded 28% of all baccalaureate degrees to African Americans. Of particular interest here, these institutions awarded 31% of the degrees in science and engineering, as African Americans at HBCUs were more likely to major in the sciences and engineering than those attending majority institutions. HBCUs have been noted for their welcoming, supportive environment [10]. The University of the Virgin Islands (UVI) is an HBCU with an enrollment of approximately 2,500 students on two campuses and is the only HBCU outside of the continental United States. It was chartered in 1962 and the first campus opened on St. Thomas in July 1963 as the College of the Virgin Islands. In 1964, the college founded a second campus on St. Croix. They initially offered Associate of Arts degrees but in 1967 added Bachelor's degree programs in liberal arts and education. The University of the Virgin Islands has since grown to offer majors in three schools (Nursing, Business and Education) and two colleges (Liberal Arts and Social Sciences and Science and Mathematics). The College of Science and Mathematics offers bachelor's degrees in seven areas including applied mathematics, biology, chemistry, computer science, marine biology and mathematics, as well as two master's degree programs. In the College of Science and Mathematics the past two freshmen classes have averaged approximately even distribution by gender, although the overall entering class was 67% female. As a result of the overall imbalance, UVI has begun a Male Initiative that has resulted in a student group, "Brothers With a Cause", with the goal of attracting more male students to the University and providing tools and support to help them graduate. Partnerships between these types of institutions can lead to mutually beneficial results if properly developed.

## **PROGRAM DEVELOPMENT**

UF, CU, USC joined with UVI as partners in the NSF SEAGEP program. One component of this program is to increase the number of minority students who are prepared to enter graduate programs. UVI already had dual degree engineering programs with Columbia University and Washington University in St. Louis. Dual degree programs serve several purposes. First, they make a degree available to students that are not offered on their home campus. Secondly, as the first two years in an engineering program have a high attrition rate, being able to complete the early years at an HBCU could avoid some of the problems that lead to attrition in these critical years [4]. Also, it has been noted that students often prefer to go to a school that is close to home, and so having options closer to the Islands is a plus.

The SEAGEP dual degree program with UVI was initially established with UF. Plans are underway to expand this to both USC and CU, and an agreement has already been signed between UVI and USC. The benefits to students to having additional choices in the southeast have been mentioned. The partnership also benefits the engineering colleges, all of which are committed to increasing the diversity of their student body.

The UF College of Engineering is the largest professional school, the second largest college and one of the three largest research units at the University of Florida. Interdisciplinary research programs unite members of the engineering faculty with colleagues in chemistry, dentistry, forest resources, geography, geology, mathematics, medicine, physics, psychology, speech and zoology. With 11 departments, it offers students a breadth of opportunities not found on every campus. The College ranked 16th in the nation in undergraduate engineering programs and 14th in graduate engineering programs among public institutions [8]. UF is positioned to provide exceptional educational experiences to a diverse group of undergraduates. USC engineering is moving into the new emerging fields of biomedical engineering, bioinformatics and atomic level engineering. This year they graduated their first class of biomedical engineering Bachelor's degree students. In addition to traditional engineering discipline, CU has a number of research centers including The Clemson University International Center for Automotive Research (CU-ICAR), an advanced-technology

research campus where academia, industry and government organizations engage in a partnership to advance the knowledge base critical to the automotive industry.

The dual degree program developed through SEAGEP is fundamentally different than others offered to UVI students. At Columbia, UVI students join others from 101 institutions who can also participate in the dual degree program, and at the University of Washington, they join students from 64 institutions. Data show that minority students who transfer (either from a community college or another 4 year school) have lower completion rates than students who do not transfer [11, 12]. This indicates possible barriers and challenges exist that must be addressed to ensure that not only do the students have the opportunity to transfer in, but that they then go on to graduate with their Bachelors degrees. A "seamless transfer" is necessary to ensure success [13] and close collaboration between the two institutions is a must [12]. Some of the institutional barriers faced by transfer students are the lack of a designated transfer advisor, financial barriers, and on-campus housing issues [11]. Once enrolled, students face additional challenges: potential culture shock caused by different institutional cultures, a drop in GPA, and higher attrition rates.

The program with UF takes a comprehensive approach to remove institutional barriers and help the students with the challenges described above. UF has a designated person who serves as the transfer coach for the College, and on-campus housing is available to these students. Additionally, at UF full-time students from Latin America and the Caribbean (including Puerto Rico and the U.S. Virgin Islands) who receive scholarships from the federal or state government qualify for in-state tuition. To alleviate any potential financial burden, SEAGEP has provided UVI students with scholarships that make them eligible for this program, significantly reducing their tuition. This has now been assumed by the College of Engineering, institutionalizing the program. As UF is experiencing a period of tuition increases in which could be as much as a 15%, this component will be even more important.

There is no question that UVI students face culture shock. These students are moving from a school with an enrollment of 2500 to one of 50,000 students. They are leaving a primarily undergraduate HBCU to attend a Research Extensive institution. They are moving from an Island environment, to a college town in rural Florida, and they are moving 1346 miles away from home. To address this issue, students have regular contact with the campus mentor, periodic get togethers of the group, and the group previously enrolled serves as peer mentors for the new enrollees each fall. Several of the students are enrolled in the same courses and elect to live together as well.

Perhaps the most important component designed to ease the transition to UF is that they are given the opportunity to live on campus during the summer before they enroll. Past cohorts have been recruited into summer research experiences so that they could acclimate to the campus and community during the 10 week summer when the student population is significantly lower. It also allowed them to start networking with UF faculty and students through their research. In addition, the majority of the students have continued to conduct research on campus, further strengthening the ties between them and faculty and graduate students. This two-way collaboration is illustrated in Figure 1.

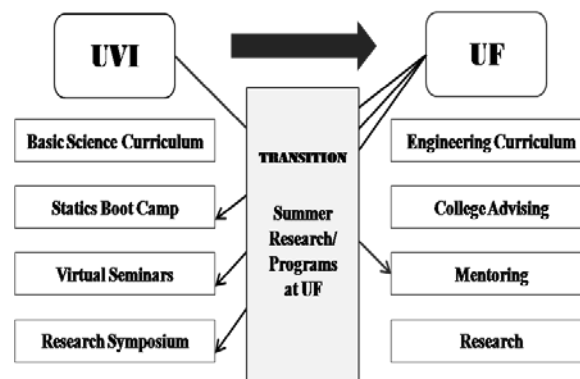


FIGURE 1  
A Model for a Comprehensive Dual Degree Program

To date, two cohorts of a total of 7 students have elected to earn this dual degree and of these, six are now participating in the program (three males and three females). Some have experienced a drop in GPA. When desired, these students have been assigned a graduate tutor from the SEAGEP graduate group to help them with problem courses. Only one student of these first two cohorts has left the program due to a family crisis.

## LESSONS LEARNED

The program is continuously monitored with a formative evaluation approach by both UF and UVI administrators and it is still being improved to ensure that the students will be successful. Personal contact with students facilitates participation in the program. Therefore, SEAGEP administrators give seminars describing the program at UVI and have

attended the annual Undergraduate Research Symposium so the students have personal contact with SEAGEP representatives from all three SEAGEP campuses.

There are several courses that have been identified as particularly challenging to the UVI students, including circuits, and statics. Unfamiliarity with Matlab was also noted as a potential barrier to success in the circuits class. SEAGEP has begun to address these issues. This summer, SEAGEP has sponsored a 3 week "Statics Boot Camp" on the UVI campus, taught by a UF professor. This will give the students the foundation they need to handle this particular course in the fall. Additionally, plans to teach Matlab at UVI have been discussed, and various UVI professors have introduced Matlab into their courses, such as Numerical Analysis, as well as in the research that they do with pre-engineering students.

Another lesson learned from the first cohorts is that many students are not aware of the breath of opportunities that engineering offers. To help address this issue and help students make informed choices about the program they would like to pursue, this past semester, another collaborative effort was established. UVI had a materials science engineer on site to teach an Introduction to Engineering course. He was limited however as he was the only engineer on the campus. SEAGEP provided weekly lectures by engineers from 11 different disciplines via Adobe Connect, so that the course participants were able to hear from and question faculty from all three universities in many disciplines, enhancing their exposure to engineering careers.

While the core of the program is the dual degree program that will allow students to earn an undergraduate engineering degree not available to them on their home campus, it also is providing them research experience and contact with graduate students. Of the 2008 VI high school SAT takers, 28% indicated an interest in achieving a Masters degree and 20% indicated a desire to achieve a PhD, so this program also has the potential to encourage and prepare them to continue to graduate school. Although the short-term goal for the SEAGEP institutions is to increase the diversity of the undergraduate students, it may have a longer-term goal of increasing the diversity of the graduate population as well.

## EVALUATION

As the program has progressed, we have relied on formative evaluation to monitor and alter components as necessary. Both individual and group meetings have provided administrators with information about the progress and social integration of the students. Additionally, academic performance has been monitored. Initial results were used to add the summer statics boot camp and to consider Matlab training described above. Student progress, graduation and post-graduation placements will all be tracked.

Student comments about the program include references to how the program has helped them overcome many of the challenges that have been identified by the literature, including their appreciation for the personal advising that they receive, the ability to network with a variety of people, the opportunity to start closer to home, and the opportunity to earn a degree that was not available to them on their home campus:

- *The dual degree program has enhanced my educational career. I was able to begin college in the comforts of my home, which made my transition from high school to college easy. My home institution, UVI, prepared me enough for college work loads I would expect when I transfer to another university. When it was time to transfer to UF, I felt prepared and this confidence made my transfer less stressful. The best part of the dual degree program is that it is a great way for me to earn two degrees at two different universities and still be able to pay in-state tuition. I've learned a lot and met many wonderful classmates, faculty, and staff at both universities. I recommend this program to any student seeking an engineering degree, especially students who may have initial difficulties with handling living away from home.*
- *Having a dual degree program has meant the world to me. It has given me the opportunity to have a better outlook on the world. This program has taught me many skills that I wouldn't have learned otherwise. These include, interacting with people from different backgrounds, experiencing life beyond the Virgin Islands, and allowing me to network with colleagues and professors that may positively impact my future. All in all it is an extraordinary program that is coordinated by people that are very passionate about broadening the knowledge of students, and I am honored to be a part of it.*
- *Being part of the dual degree program has given me an opportunity to obtain an engineering degree which wasn't offered in UVI. This program gives you a chance to start off at a smaller university and then branch off rather than starting off at a big university straight out of high school which may be overwhelming for most people.*
- *Being able to take part in the Dual Degree program has given me a chance to expand my horizons. It has shown me that there are opportunities out there and that there are people who are willing to take the time to give a guiding hand to the effect of helping me achieve my goals.*
- *The University of the Virgin Islands gave me a solid foundation in an intimate environment and the University of Florida has taught me how to learn, network and compete on a larger scale.*

## INSTITUTIONALIZATION

The goal of the NSF SEAGEP program ultimately is to develop programs that will be institutionalized and become part

of the infrastructure of the college. In the case of the dual degree program, the College of Engineering was instrumental in putting institutional structures in place to establish the program. Beginning this fall, the College will assume the UVI scholarships that will allow the participants to receive in-state tuition rates. Additionally, a UVI advisor will be identified in the College Office of Students Services who will be tasked with providing targeted advising for these students. In these ways, the collaboration initially facilitated by SEAGEP with financial support from NSF will become a part of the infrastructure of the College of Engineering and provide these opportunities long after the NSF funding has ended.

## SUMMARY

A successful dual degree program is more than an articulation agreement. It has been shown that transfer students, particularly underrepresented minority students, face significant challenges. Close cooperation between institutions, personal contact with students, and appropriate advising and support structures are all necessary for these students to succeed. The SEAGEP dual degree program has incorporated these components, and has remained vigilant to identify and address issues and concerns as they arise. UF is already benefitting by diversifying the undergraduate student population, and perhaps eventually the graduate student population as well. Wherever the students choose to go to graduate school, they will contribute to diversifying the student population there and ultimately the engineering workforce. UVI now has a more local, personalized outlet for their students to pursue engineering degrees, and two more when USC and CU become operational. As these degrees traditionally attract male students, over time it may even contribute to increasing the enrollments of male students. When developed properly, these programs benefit all participants, increase enrollment in engineering fields, and add to the diversity of students pursuing engineering degrees.

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