Insights on Retention of Underrepresented Minority Electrical and Computer Engineering Transfer Students (Experience)

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Abstract

From 2009-2013, Texas A&M University (TAMU) received funding for the Engineering Transfer Scholar (ETS) project under the National Science Foundation Scholarships in Science, Technology, Engineering, and Mathematics (NSF S-STEM) program. The goal of ETS was to increase the quantity, quality, and diversity of the engineering workforce in the state, the United States (US), and globally through enabling academically talented and financially needy students to transfer from two-year community colleges or four-year universities to TAMU to obtain baccalaureate degrees in engineering or computer science. The goal was accomplished through scholarship funding and engagement of ETS students in a complementary focused learning community that included academic and social components to improve the students' educational opportunities and retention. Two focal points of this project were (1) linking and leveraging the Texas A&M University System (TAMUS) Louis Stokes Alliance for Minority Participation (LSAMP) program's community college partnerships and (2) complementing the TAMUS LSAMP and TAMU College of Engineering (COE) recruitment and diversity efforts with ETS scholarships and matriculation activities. The targeted transfer institutions and community colleges had high student enrollments of African American and Hispanic American students, two historically underrepresented groups in STEM fields in the US. Twenty-two (22) of the thirty-five (35) ETS participants were underrepresented minority (URM) students. Almost half (17/35) of ETS participants transferred to TAMU as electrical and computer engineering (ECE) (13) or computer science (4) majors. **Ultimately, 29 of the 35 (about 83%) ETS participants completed bachelor degrees after transferring to TAMU.** This paper discusses activities, successes, and challenges during the project implementation and reflections on important findings, which demonstrated successful retention components for ECE students. Feedback from ETS participants and a comparison with another NSF S-STEM project is given.

Introduction

The Engineering Transfer Scholar (ETS) National Science Foundation Scholarships in Science, Technology, Engineering, and Mathematics (NSF S-STEM) project initially targeted transfer students for three departments in the College of Engineering (COE) at Texas A&M University (TAMU): Electrical and Computer Engineering (ECE), Nuclear Engineering, and Computer Science. The project objectives included increasing transfer and subsequent matriculation of a diverse group of students to engineering and computer science majors at TAMU, and retaining ETS scholars to degree achievement in engineering and computer science.

In [1], data indicated that "the majority of college graduates no longer earn their degrees at a single institution…" and those enrolled at community colleges seeking a baccalaureate must transfer, but more than 58% did not transfer. Published in 2008, [2] noted that students enrolled at community colleges were 46% of all undergraduates in the United States (US), heavily first generation (parents had not earned a bachelor degree), and often underrepresented minority (URM) (African American, Hispanic, or Native American). In Fall 2016, 36% of all US

undergraduate students were enrolled in two-year colleges [3]. According to [4], 50.8% of Hispanic and 48.5% of African American of the Fall 2010 cohort of students who graduated within six years started at two-year colleges. Further, [5] reported that in 2004-2005 there were more Hispanic undergraduate students enrolled in two-year colleges (approximately 934,000) than four-year institutions (696,000). In Fall 2016, that dynamic had shifted with more Hispanic undergraduate students in four-year institutions (about 1.59 million) than two-year colleges (1.47 million) [3]. In states with high Hispanic populations, such as Texas, recruiting this large pool of URM students to transfer to STEM majors at four-year institutions becomes extremely important to increase the number and diversity of students obtaining engineering bachelor degrees.

To recruit students, ETS targeted seven two-year institutions that had existing relationships with TAMU and had high enrollment rates of African American or Hispanic students to develop a diverse pool of talented students. The partner institutions included Hispanic Serving Institutions (HSIs) and a Historically Black College and University (HBCU). Institutions designated as an HSI have enrollments of at least 25% Hispanic students [6]. HBCU institutions were established before 1964 primarily to educate black Americans [7].

The first cohort of ETS students started in the Fall 2010 semester. The students were recruited from partner community college institutions and relationships established at a Community College STEM conference hosted by the Texas A&M University System Louis Stokes Alliance for Minority Participation (TAMUS LSAMP) program. TAMUS LSAMP partnered with ETS in November 2009 at TAMU to inform potential transfer students and advisors of resources available during the transfer process and to motivate students to pursue STEM bachelor degrees. TAMUS LSAMP, an NSF-funded project comprised of partner institutions--TAMU, Prairie View A&M University, and Texas A&M University-Corpus Christi-- aims to increase the number of URM students completing baccalaureate and graduate degrees in STEM fields and, ultimately, entering the STEM workforce including academia.

Students were selected for ETS scholarships based on the following eligibility criteria: US citizens or permanent residents of the US, majoring in engineering or computer science, demonstrated financial need, demonstrated academic potential, and the ability for transfer admission. ETS scholars could renew their scholarships for up to three semesters (approximately 2 years) if they demonstrated progress toward their degrees and maintained a minimum 2.75 cumulative grade point average (GPA). Students who fell below the requirements were placed on a one-semester probation period and received a counseling session with their academic faculty advisors to discuss academic difficulties.

In addition to the scholarships, ETS participants attended the Success Seminar Series along with students participating in the TAMU Engineering Living Learning Community (ELLC). The ELLC housed students in a common dormitory, conducted seminars, provided peer-tutoring, and facilitated networking opportunities with upper-class students and first-year engineering majors and student organizations. The Success Seminar Series involved a 30-60 minute presentation by a guest speaker, followed by a 30-minute community building activity. Selected topics included study skills, goal setting and time management, professionalism, and career preparation. ETS

students were also provided tutoring support and attended ETS special topic seminars, which allowed scholars the opportunity to engage in discussions as a small cohort. Seminars were relevant to transfer students' experiences. Topics included preventing "transfer shock," overcoming advisement issues, and exploring research opportunities including NSF research experiences for undergraduates (REUs). ETS participants also learned about graduate school opportunities including the TAMUS LSAMP Bridge to the Doctorate program.

Results and Insights

ETS hosted thirty-five (35) total students in three distinct cohorts. Eleven (11) students initiated ETS Cohort 1 in Fall 2010. ETS Cohort 2 began Spring 2011 with seven (7) students, and ETS Cohort 3 began Fall 2011 with seventeen (17). Eighteen (18) of the ETS participants were electrical engineering, computer engineering, biomedical engineering, or computer science majors. In addition to the seven targeted institutions, ETS students transferred from seven other 2-year and 4-year institutions. Twenty-five (25) ETS participants transferred from 2-year institutions, and ten (10) transferred from 4-year institutions.

Twenty-two (22) of the ETS participants were URM students: eighteen (18) Hispanic and four (4) African American. Nine (9) students were Caucasian, and four (4) were Asian. Thirty (30) males and five (5) females were a part of the program.

Despite the community building and other strategies put in place to promote ETS students' success, several of the ETS students performed below the minimum GPA of 2.75. The program released thirteen (13) students (six from Cohort 1; four from Cohort 2; and three from Cohort 3) for falling below the minimum GPA. When students transferred, their GPAs reset to 0.0 at TAMU. Hence, they did not have a buffer to absorb any 'C' and below grades received during their first couple of semesters at TAMU.

Further, the ETS management team discovered that the eighteen (18) students in Cohorts 1 and 2 matriculated in eleven (11) different majors. As a result, the students rarely were in common course sections, and hence, students found it challenging to study together.

To combat the program attrition and lack of common course schedules, the ETS management team decided to develop a disciplinary critical mass for Cohort 3. For the Fall 2011 cohort, nine out of 17 participants were ECE majors. Since the students started the same semester, this allowed them to enroll in similar courses and form study groups together, further establishing community and connectedness.

Participant Feedback

In the spring of 2012, the West Texas Office of Evaluation and Research (WTER) conducted a survey and focus groups with ETS scholarship recipients. The purpose of conducting the survey and focus groups was to identify (1) the impact of S-STEM scholarships; (2) ways to improve the scholarship project; (3) difficulties students had in transferring to TAMU; and (4) ways to improve the transfer process.

To ensure all ETS participants had a chance to provide individual feedback about their transfer and ETS experiences, participants were asked to complete the survey before the focus group discussions began. Nineteen (19) students provided information on the survey and participated in the focus groups. WTER conducted two back-to-back focus groups with nine (9) students in the first group and ten (10) in the second group. The first group lasted about 40 minutes, and the second group lasted almost 50 minutes. WTER conducted both focus groups using similar procedures.

Overview of Student Perceptions

All of the students were very complimentary of the ETS project and were very grateful for the scholarship. Several students even indicated that without the scholarship, they would not be in school. They agreed about the value of the project's seminar series, especially for new transfer students; however, they had numerous suggestions for other seminar topics to offer scholarship recipients during their second year. Students praised ETS project leaders for their concern for student success and the help project leaders provided the students. In contrast, ETS participants viewed their academic/departmental advisors as impersonal and non-caring. Participants also expressed concern about the two-year limit on their scholarships since students anticipated needing more than two years to graduate.

During the application and transfer process, students experienced problems in getting timely notifications about their document submissions and in making contact with advisors. Some students were also frustrated because several courses taken at their initial institutions did not transfer or did not satisfy TAMU degree or program requirements.

Reflecting back on their first semester at TAMU, students reported that the courses were harder than at their previous institutions, that they had taken burdensome course loads based on inadequate advising, and that they experienced drops in GPAs and feelings of intimidation and loneliness. Students learned how important mentors could be and indicated that they would be willing to mentor other students. They also learned that studying with others was much more important at TAMU than it was at their previous institutions. Students provided advice for future transfer students and for improving the transfer process through better advising, mentoring programs, and student understanding of what courses to take before transferring. The following sections provide detailed student feedback based on themes from the purposes of the survey and focus groups.

Impact of ETS Scholarship

The students agreed that the ETS scholarships were very important to them because of the money it provided. "I have to have the scholarship to be able to afford to go to school." "Without this scholarship, I would not be here." "It would be much more difficult if I had to work three jobs to be able to afford school." The scholarship "gives you one less thing to worry about" and "takes financial stress away."

Students valued the opportunities and support provided by the ETS project leaders. They indicated that being ETS scholars was "a big motivator" and that it "helps you stay focused." Having this scholarship was an "incentive to me to try to do well so that I can get more scholarships."

Participants also valued the project's seminars. Students indicated that the seminars hosted during the first year were especially valuable because they helped students get oriented to TAMU and learn about time management techniques and study skills. ETS scholars also mentioned learning about transfer shock. Other students commented on seminars that focused on what you can do with various degrees and certifications and suggested there should be more seminars on career pathways, especially during students' second year with the project.

Two of the students had attended the TAMUS LSAMP Symposium and indicated what they learned about graduate school there was very valuable. "I had never thought about grad school. So, this information was really good."

Students were complimentary of the support provided by project leaders. "I told my S-STEM advisor that I was having trouble in class, and they paid for a tutor to help me." "It has been good to have a smaller group and a person that is available to help us."

Suggestions for Improving the ETS Project

A large number of students expressed concern about the two-year limit on the ETS scholarships. They stressed that it takes "longer than two years to graduate" and that "engineering is not really a four-year program." One student shared that "I feel pressure to graduate in two years before this scholarship ends. So, I am trying to take heavy loads to get finished in two years."

A number of students commented about the project's seminars. They agreed about the importance of the seminars but were concerned that they became repetitive for students in the second year. Students made the following suggestions for seminar topics: what you can do with your degree; certifications that you can get; information about different engineering fields; graduate school; GRE; research opportunities for students; internships; résumé writing; how to find a job; and how to interview for a job. Students suggested hosting the first seminars meeting before classes began, as it may be a good chance to help students mentally prepare for their classes and could serve as an orientation for new transfer students. Some students wanted less frequent seminars, stating two meetings a month was too much. Hosting meetings every three weeks or so was suggested.

ETS participants also suggested informing new transfer students about tutoring resources. Inviting departmental advisors and professors to the ETS seminars so new students can meet staff and faculty were other suggestions. Professors could discuss their research and provide insight on career paths and opportunities available for students in their various disciplines. This would allow students to meet professors on a more personal level.

Several students discussed the TAMU COE career fair, and some suggested that students be required to attend the Fall semester career fair and not just the one held in the Spring semester.

Students also suggested that the project help students prepare for the career fair and understand the importance of that preparation. Students needed to "focus on their résumés before the career fair" and "learn how to handle themselves" at the event. Students also suggested that it was important to know "what to do after the career fair as follow-up."

Experiences at Their Initial Institutions While Preparing to Transfer to TAMU

When asked what difficulties or obstacles they faced in transferring to TAMU, several students focused on important transfer documents. Some students seemed to have difficulty in talking with individuals at TAMU about their transfers. Determining if courses transferred seemed to be another issue for a large number of the students. Some students did not realize that there was a difference between courses transferring and courses meeting specific degree or program requirements. One student shared that "sometimes the community colleges don't have the information that students need about what courses are really going to transfer because they are not thinking about anything beyond your getting an associate's degree." Another student shared, "There is a problem for out of state transfers because there aren't common numbers. So, you don't know what will transfer until they evaluate it here at TAMU, but this can create problems because of the limits of the number of hours and having to pay out of state tuition. It would really help if there was someone to call that could help with course selection (at initial institution)."

Several students commented about the mistakes they made in selecting their courses for their first semester at TAMU. Several students indicated that they took too many hours, and they took classes together that would have been better to take in different semesters.

One student pointed to the value of participating in the transfer information day because he/she got answers to financial aid questions and was able to talk to an advisor specific to his/her major. Another pointed to how helpful the TAMU regional prospective student center was where he/she could talk to someone about transferring.

Suggestions to Improve the Transfer Process

The most common advice these students offered to other students about the transfer process related to the amount of time to allow. "People don't realize how much time it takes to get everything done to transfer." ETS participants provided advice for students before they transfer and suggestions on how to provide better assistance for transfer students. Students advised future transfer students to visit TAMU to speak in-person with advisors or to speak with representatives who recruit to ensure everything related to the transfer process goes smoothly. Students should be clear about which courses transfer and fulfill degree requirements at the new institution.

Suggestions for TAMU included providing more virtual opportunities for transfer students to get information. In addition to hosting on-campus transfer information days, TAMU could have virtual workshops for those experiences. At new transfer student conferences, peer mentors would be helpful to assist students with their schedules. New transfer students need to know which courses to take together. ETS participants felt that departmental advisors did not have an adequate perspective. One student stated, "Advisors have this formula they use to tell you what

classes to take but sometimes what you transfer doesn't fit the formula. So, you need students to tell you which classes to take, which professors to get, and how many classes to take."

Experiences of Transfer Students at TAMU

Many of the students had vivid memories of their experiences when they first transitioned to TAMU. Several students described their experiences with words like "hard," "stressed," and "intimidating." They agreed that they found almost everything different at TAMU than at their previous institutions and that their grades dropped.

An ETS participant noted, "I still remember my first day of classes [at TAMU]. First, I didn't know where I was going. Then when I found where I was supposed to be, there were 200 people in my first lecture." Other students stressed the importance of seeking out and establishing a community. Several students learned that staying in contact with classmates about assignments and utilizing tutorial resources were helpful. Students studied with classmates and had to spend more time studying than at their previous institutions. One student shared, "I have been here two years, and I still don't have a sense of belonging," while another student stated, "At the community college, I knew everyone. It was hard here at first, but now I have friends to interact with and I feel part of the campus."

Suggestions to Help Transfer Students at TAMU

Students provided suggestions for how transfer students can deal with and/or overcome the difficulties associated with transitioning to TAMU. Several pointed to the need for transfer students to have a mentor, especially during the first semester, and many expressed a willingness to mentor other transfer students. "We could help other transfer students. Even if we don't know the answers to their questions, we could help direct them to someone who could help."

ETS participants felt other transfer students needed to realize the difference in the overall workload at TAMU. In particular, studying was a major factor in the workload difference. ETS participants noted that studying for an adequate amount of time and spending the study time in the right way were important for success in classes. Students also felt it was important to meet classmates and study with them.

Finding a mentor during the first transfer semester was another suggestion. Participants felt mentors were important to keep mentees aware of potential opportunities and to reassure and calm mentees down during stressful periods. Mentors also provided tips to prepare mentees for any challenges. If possible, participants suggested new transfer students find a mentor who had also transferred to TAMU to share successful tips and strategies on navigating the new institution and thriving there. These peer mentors would be able to help students find the services they may need, e.g., tutoring. Peer mentors could also inform transfer students about opportunities they might not know about, e.g., how someone can obtain various certifications.

ETS participants also suggested ways for TAMU to help transfer students adjust and develop a sense of belonging. Students felt TAMU did a great job in getting entering freshmen acclimated but not as much for transfers. More efforts and attention needed to focus on acclimating transfer

students. ETS participants also wanted venues that would help transfer students get involved in various campus groups and get to know other students.

Other Student Comments

At the end of both focus groups, WTER asked students if there were any other important things to share. The additional comments focused on the value and strengths of the project leaders. Students described the leaders as "awesome," "advocates that go to bat for us," and "very approachable." Several students compared the project leaders with their departmental/academic advisors. "Advisors don't like you to come without an appointment, but we can call the project leaders at any time, and they also respond quickly to emails. They give us answers quickly. The project leaders make time for us." "They (project leaders) care about us and want us to succeed. To advisors, we are just a number." "The ETS leaders know our names and who we are. They serve as advisors and give much better advice than our real advisors." Another student shared that the "weekly checkups are a good idea."

Conclusions

Nineteen (19) students completed the ETS program, and sixteen (16) left or were released from the program. All 19 students who completed the ETS program graduated from TAMU with a STEM engineering, engineering technology, or computer science degree. Ten (10) students who left or were released from the ETS program still graduated from TAMU. Eight (8) of those who left or were released completed engineering degrees, and two (2) completed non-STEM bachelor degrees. So, 29 of the 35 (about 83%) ETS participants completed bachelor degrees after transferring to TAMU. A list of ETS students' bachelor degrees and the number who graduated with that degree is as follows:

- Electrical Engineering (9)
- Computer Engineering (2)
- Computer Science (1)
- Biomedical Engineering (1)
- Engineering Technology (3)
- Industrial Engineering (3)
- Aerospace Engineering (2)
- Mechanical Engineering (2)
- Non-STEM Major (2)
- Biological and Agricultural Engineering (1)
- Chemical Engineering (1)
- Civil Engineering (1)
- Radiological Health Engineering (1)

Eight of the nine ECE students in Cohort 3 completed the ETS program. Further, all nine of the ECE ETS Cohort 3 students graduated from TAMU with an average GPA greater than 3.0.

The twenty-nine (29) students who graduated from TAMU had an average GPA of 3.001 and an

average time to degree (TTD) of 3.41 years. *Note that the TTD does not account for the time students spent before transferring to TAMU*. For graduates who completed the ETS program, the average GPA was 3.203, and the TTD was 3.18 years. Those students who graduated from TAMU but left or were released from the ETS program had an average GPA of 2.618, and the TTD for them was 3.85 years.

For the twenty-two (22) URM ETS participants, twenty (20) graduated (17 Hispanic Americans and 3 African Americans) from TAMU. The average GPA for URM ETS participants who graduated was 2.935, and the average TTD was 3.38 years. For those fourteen (14) URM ETS participants who graduated and completed the ETS program, the average GPA was 3.199, and the average TTD was 3.14 years. The six (6) URM ETS participants who graduated from TAMU but did not complete the ETS program had an average GPA of 2.321 and an average TTD of 3.92 years.

Table 1 compares the ETS program at TAMU with another NSF S-STEM program hosted at the University of Massachusetts [8]. Both S-STEM grants at the University of Massachusetts Amherst and TAMU focused on transfer student success. Note that the University of Massachusetts Amherst had another S-STEM grant (Grant #2 in [8]). This second grant was not included in the table as that grant supported graduate and undergraduate students.

Table 1: NSF S-STEM program graduation rate comparison

		Number of Students	**Graduated from University**		**Graduated from COE**	
			Number	**Percent**	**Number**	**Percent**
TAMU						
	Cohort 1	11	11	100%	11	100%
	Cohort 2	7	2	29%	1	14%
	Cohort 3	17	16	94%	15	88%
	Overall	**35**	**29**	**83%**	**27**	**77%**
Univ. Mass. Amherst						
	Grant #1	39	35	90%	34	87%
	Overall	**39**	**35**	**90%**	**34**	**87%**

For future transfer student programs, one consideration would be the minimum GPA requirement of 2.75 for transfer scholarship students. Was this minimum GPA appropriate given that students' GPAs reset after transferring? The ETS management committee wanted to incent students to do well academically noting that many employers desire a 3.0 GPA in order for students to interview for full-time employment or internship opportunities. However, the ETS management committee needed to determine a different academic standard as an indicator of successful transition since in the end most of the students did graduate from TAMU.

Another insight from the ETS participants is that all of the students who completed the ETS program had taken introductory engineering courses at the community colleges or institutions the students attended before transferring to TAMU. None of those who left or were released from the ETS program had taken these introductory engineering courses. This may suggest that transfer students who completed the introductory engineering courses were better prepared for the rigors of the engineering coursework at TAMU than those students who had not completed the courses. Further, most students made 'C' grades in their TAMU Foundations of Engineering II courses, which focused on computer programming. This may suggest that many of the transfer students may not have had previous computer programming experience.

Since the ETS project ended, TAMU COE has partnered with Chevron and several two-year institutions across Texas to form the Engineering Academies [9], [10]. The Engineering Academies are unique programs in which students are co-enrolled at the two-year institutions for one or two years and then transition to complete their TAMU engineering bachelor degrees in residence at College Station, TX. The Engineering Academies programs include components that address several concerns that ETS participants noted in their transfer experiences: building a community of academic peers, aligning pre-transfer coursework with eventual degree requirements to minimize non-transferable courses, and acclimating transfer students to the TAMU campus culture. Students in the Engineering Academies begin their journeys in cohorts and take math, science, and engineering courses together at their two-year institutions [9], [10]. Coursework for participants in the Engineering Academies aligns with engineering degree plans at TAMU, and COE faculty reside and teach at each of the two-year institutions [9]. During their first and/or second years at their two-year institutions, students enrolled at the Engineering Academies visit the TAMU campus in College Station for engagement experiences to help acclimate the students for their eventual residence there. Past engagement experiences included attendance at sporting events and participation in the engineering career fair and in dedicated TAMU career center and TAMU academic success center sessions [9].

One persistent concern for students transitioning to the College Station campus from an Engineering Academy and for traditional transfer students is the level of financial support when students complete degrees at the College Station campus. TAMUS LSAMP has partnered with the Engineering Academies to offer stipend support for Engineering Academies students who engage in research experiences at TAMU. Providing scholarship or other funding opportunities for many transitioning and transfer students is critical to their success.

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