Scholarships for Academic Success Program: A Final Report

Dr. Carolyn Skurla, Baylor University

Carolyn Skurla is an Associate Professor and the Graduate Program Director in the Department of Mechanical Engineering at Baylor University. She received a B.S. in Biomedical Science from Texas A&M University and a Ph.D. in Mechanical Engineering from Colorado State University.

Dr. Steven R. Eisenbarth, Baylor University

Professor Eisenbarth has 33 years of teaching exerience in the fields of electrical and computer engineering and computer science at Baylor University where he has served as Associate Dean for Undergraduate Engineering and Computer Science Studies and more recently as the Associate Chair of the Electrical and Computer Engineering Department. He has developing interests in international education and has a faculty appointment at Pyongyang University of Science and Technology, DPRK.

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Abstract

The primary goal of the Scholarships for Academic Success (SAS) Program, funded through an NSF S-STEM grant, was to attract transfer students from regional community colleges and four-year institutions without engineering and/or computer science programs into the fields of engineering and computer science through an academically competitive financial assistance program. The second goal of the SAS Program was to ensure the success of the scholarship recipients once they arrived on our campus.

Because our institution historically enrolls a small percentage of transfer, older-than-average, and other non-traditional students, these students often experience difficulty connecting with their classmates and integrating into the university community. Special programs and events designed to build a cohort of SAS students were intended to provide the students with support services and resources to build a sense of community and to ensure retention through the completion of their degree. SAS Scholars were familiarized with campus resources that provide support, encourage success, and help students improve study skills. Mentoring activities included teaching life and career skills, providing faculty and industry mentors, encouraging students to seek summer internships, and providing them with services, resources, and events to assist them in the transition to engineering and computer science programs at a 4-year university. The introduction of SAS scholars to each other provided the students with an instant support network of classmates and student-mentors. Through career counseling and focused student/faculty interaction, this project was intended to help students complete their degree programs in the shortest time possible.

SAS scholarships, totaling $458,600 over 5 years, were awarded to fifty-four academically talented students of limited financial means. Preliminary analysis of retention data indicates that SAS scholars were successful in their engineering and computer science (ECS) majors to a greater degree when compared to traditional students (i.e., students enrolling at our university as freshmen directly after high school graduation) and to transfer students who were not eligible for SAS scholarships (i.e., non-SAS transfer students):

- Percent retention of SAS scholars in ECS majors was 39% greater than traditional students and 103% greater than non-SAS transfer students.
- The percentage of SAS scholars who changed their major from ECS to another major at this university was 40% less than the percentage of traditional students and 57% less than the percentage of non-SAS transfer students who changed their major from ECS to another major.
- The percent drop-out rate for SAS scholars was 61% lower than traditional students and 73% lower than non-SAS transfer students.
- SAS scholars, regardless of major, graduate from this university at a rate that approaches the university-wide graduation rate, regardless of major.

Introduction

The primary goal of the Scholarships for Academic Success (SAS) Program, funded through an NSF S-STEM grant, was to attract transfer students from regional community colleges and four-year institutions that do not have engineering and/or computer science programs into the fields of engineering and computer science through an academically competitive financial assistance program. The rationales for this program were the desire to increase the diversity of the engineering and computer science workforce, to improve retention to graduation, and to encourage intellectual development.

Increase the diversity of the engineering and computer science workforce.

According to Chubin *et al* [1], "Women and underrepresented minorities are not entering undergraduate programs in engineering in the same proportions that they did several years ago." Whereas underrepresented minorities achieved gains in computer science from 1981 to 2001, the percentage of women earning a bachelor's degree in computer science peaked in 1985 at 37 % and declined to 27.3 % in 2001[1]. In addition, engineering and computer science has not just a diversity problem but also a bigger problem with "cultural competence." The issue of a homogeneous workforce's ability, or lack of ability, to provide goods and services to an increasingly diverse population as well as its ability to compete in a global marketplace requires that these disciplines attract and retain a more diversified student body and mentor them through the completion of their baccalaureate degree[2]. We hoped that the recruitment of students from community colleges into a program with specific mentoring objectives would contribute to the diversity of the engineering workforce.

Court rulings made shortly before the awarding of our NSF S-STEM grant prohibited our university from considering gender, race, or ethnicity in all activities of our university. However, we hoped that STEM workforce diversity could be increased by focusing on first-generation college students because underrepresented minority students make up a large percentage of first-generation college students.

Improve retention to graduation.

According to Peterson *et al* [3], "Factors that negatively impact minority students' success in engineering include finances, academic preparation, difficulty envisioning themselves as engineers, and lack of community on campus." This is true for computer scientists as well. We planned to help well qualified students with limited financial means to overcome a significant personal barrier to their academic success. Brown *et al* [4] studied the perceptions of campus climate on the graduation rates of African American engineering students and concluded that "institutional commitment was found to play a favorable role in influencing graduation rate among African American students." Brown *et al* further concluded that universities should look for opportunities to reinforce the students' perception that they made the best choice regarding which university to attend. A number of universities have instituted special programs in STEM disciplines to increase recruitment of women and underrepresented minorities and to improve retention to graduation. In many cases, the students are awarded with scholarships providing they meet program requirements, which include full-time enrollment in the university, financial need,

the ability to maintain a minimum GPA per semester, and to meet additional program requirements that are set forth in a contract that the student must sign[5]. In the case of one university, the funds provided to the student are not called a scholarship but rather a stipend that replaces the income from a part-time job and effectively pays the students to study during the time that they otherwise would spend working to support themselves through school[5]. The goals of these programs are to provide students with the skills, support, encouragement, and guidance that will allow them to develop a passion for their field, which, in turn, will allow them to make and keep their focus on long-term career goals and short-term academic goals. In the case of women and underrepresented minorities, building connections to peers, faculty, industry representatives, and to the university community[6] are vitally important themes in how these students learn and incorporate themselves into a culture. Due to the lack of minority role models in engineering and computer science, women and minority students often have trouble seeing themselves as engineers and computer scientists[3]. Providing tools to help students develop a vision of themselves in their future career helps them to stay focused on long-term and short-term goals when coursework becomes discouragingly difficult. In order to help these students envision themselves as future engineers and computer scientists, it is important to provide opportunities for the students to interact with and to be mentored by peers, faculty, and industry professionals[1]. Since engineering and, to a lesser degree, computer science is not commonly taught in K-12 programs, many college students have trouble developing a passion for the field without being made aware of what it is exactly that people working in these fields actually do with their education on the job. Students who require a connection to their field in order to remain committed to a difficult course of study can benefit by learning from industry professionals how they work as problem-solvers who use creativity and artistic abilities to have a "direct impact on improving the lives of others[7]."

A number of reports on intervention programs designed to increase student retention reveal that those programs that succeed are those that:

- work to improve student study skills[1], including critical reading skills[7-8]; note-taking[5]; time management[7,9]; stress management, especially with test anxiety[5]; and tutoring[10].
- work to improve life skills, including dealing with family interaction issues[11]; the transition from high school or community college to university life[11]; conflict resolution[8]; money management with the focus on obtaining financial aid and avoiding student debt[7,9]; and dealing with issues of social life within the university community[7].
- work to improve career skills, including resume writing[7,9]; interviewing skills[7]; and business etiquette[11].
- increase participation in student organizations[1].
- encourage undergraduate participation in research programs[1].
- seek feedback from students and faculty[1].
- increase student interaction/mentoring by peers, faculty, and industry professionals[1].

Participants in these programs tended to achieve better grades and graduation rates among underrepresented minorities.

Encourage intellectual development.

Felder and Brent[12-13], in a review article series about levels of intellectual development described the Baxter Magolda model[12] that involves four levels of intellectual development: 1) absolute

knowing, 2) transitional knowing, 3) independent knowing, and 4) contextual knowing. Factors that encourage a student's progression of intellectual development include social and emotional influences, such as "interpersonal interactions among students and between students and instructors, cultural predispositions, and students' emotional states[12]." An educational experience that "encourages and facilitates independent, critical, and creative thinking" and provides an accepting and supportive environment inside and out of the classroom helps to lead the student to successfully progress to more advanced levels of intellectual development. Progression to higher intellectual developmental levels also correlates with growth in the areas of "moral reasoning, multicultural awareness, and tolerance for diversity[12]." Thus, the task of engineering and computer science educators is the promotion of intellectual growth so that graduates view science and engineering as "processes of inquiry" rather than the blind application of facts and formulas[12]. Felder and Brent describe the attitudes of a student who has achieved the highest level of intellectual development, contextual knowing, as one with "intellectual curiosity, openness to alternative ideas, and acceptance of responsibility for one's own learning[13]." Felder and Brent also offered this description as a definition of the thinking processes of expert scientists and engineers.

Challenges faced by transfer students.

Many students attend regional community colleges because their limited financial resources override their choice of academic major. These students are confronted with limited academic choices, especially in the engineering and computer science disciplines, because many community colleges have curtailed or down-sized pre-engineering and computer science programs in the face of flagging student interest related to the economic downturn in high-tech jobs, the threat of job losses from outsourcing, or the inability to hire qualified faculty.

Our university has developed a number of 3+2 programs with small private colleges within the state. These programs allow students to move from institutions without accredited engineering and/or computer science programs to our university after three years of academic work. Students receive a bachelor's degree from their original university as well as from our university after completing the requirements for an engineering or computer science degree. Many students who begin these programs do not complete the transfer because they lose interest or their financial resources are not sufficient to support the additional year of academic work.

A critical element of moving students through community college systems into four-year degree-granting institutions is the availability of financial assistance programs that help students overcome the impact of their limited financial resources. To that end, the objectives of the SAS program were to attract exceptional community college students and students from 3+2 partner institutions who were seeking careers in engineering and computer science into programs at our university and to support their career goals by providing the infrastructure to nurture and mentor them so that they could reach their academic goals in the minimum time possible.

SAS Program Methods and Activities

Transfer students were recruited from regional community colleges and universities with 3+2 programs. We collaborated with the Office of Admissions and the Office of Financial Aid to identify transfer students who applied for admission to our university with a declared major of engineering or computer science and to provide a package of combined financial aid and academic scholarships that would make the cost of attending our private university competitive with regional state universities without exceeding unmet financial need as specified by the student's Free Application for Federal Student Aid (FAFSA) score. A transfer student qualified for the program if he or she was a U.S. citizen or a permanent resident, had a cumulative GPA of 3.0 or above, and had significant financial need. A complete scholarship application consisted of the completed scholarship application form, two letters of recommendation, academic transcripts from all colleges or universities attended by the applicant, a completed FAFSA, and a personal narrative. Students not classified as transfer students were also invited to apply if there were additional funds available once transfer student awards were determined. Special consideration was given for students with more than 16 semester hours of transfer work, students who had served in the military, students with disabilities, and students who were first-generation college attendees. Applicants were required to have significant unmet financial need, which was defined as the FAFSA score minus all existing scholarship and need-based grants. The maximum scholarship award was $5,000 per semester and was renewable for up to a total of four semesters. The scholarship award could not exceed the unmet financial need. Scholarship recipients, called SAS scholars, were required to attend special SAS activities during the semester and to maintain a 3.0 GPA in order to qualify for renewal of the scholarship.

Since our institution historically enrolls a small percentage of transfer, older-than-average, and other non-traditional students compared to the overall student body size, these students have difficulty connecting with their classmates and integrating into the university community. For that reason, our program was designed to provide them with a social and technical support network that would improve their chances for success. Scholarship recipients were required to attend meetings once every two weeks. We alternated the session programs between technical support activities and social activities (e.g., ECS movie night).

The technical support activities were intended to help the students develop a sense of community with the other scholarship recipients and with the faculty sponsors. Additionally, they were intended to assist the students with the development of critical life skills. The technical meeting activities included:

- Session I – Student/faculty introductions; discussion focused on the intent of the scholarship program and how academic challenges differ at a comprehensive university.
- Session II – Resume writing and interview skills; resumes critiqued and improved; interview skills discussed.
- Session III - Study skills and time management.
- Session IV – Field trip to local mechanical engineering design firm.
- Session V – Importance of technical proficiency and life-long learning.

The resume writing and interview skills meeting took place one week prior to the university-wide career fair. Each SAS scholar was required to attend the career fair and meet with potential

employers regarding summer internships. Additional program activities included working with students to hone their resumes and interview skills and writing recommendations for students.

During the fall 2011 semester, surveys were sent to all individuals who had received a SAS scholarship. The survey was administered according to a protocol approved by our university's Institutional Review Board. A link was sent to each SAS scholar using the most up-to-date email address on file. A 5-point Likert scale was used ranging from Strongly Disagree to Strongly Agree. A few questions required different scales such as answering questions about student loans and the timing of their decision to major in engineering or computer science.

SAS Program Results and Discussion

Student recruiting was negatively impacted by the downturn in the national economy. Several very good scholarship offers (i.e., combined program award plus university-provided scholarships and grants) were declined because the recipients believed that staying near home and holding a part-time job was of greater financial advantage to them than pursuing full-time education. There was also anecdotal evidence that the economic downturn negatively impacted the recruitment of minority students. A total of 54 students were awarded a total of 113 semester scholarships. The average award was $4,058, and total awards amounted to $458,600.

Program Attrition

Over the 4.5 years that the program offered scholarship awards, a total of eleven students (*See Table 1*) left the program for another major at our university or left the university. Only two students in this category were not transfer students. Two students from the 2007 cohort left the program. One changed major to applied mathematics, and the other left the university due to poor academic performance. Three students from the 2008 cohort left the program. Two of these students changed their majors: one to education and the other to environmental studies. The third student transferred to another university to pursue an engineering degree. One student from the 2009 cohort left the University for unspecified reasons. Two students in the spring 2010 cohort changed major: one to biology and the second to business. One student was dropped from the scholarship program because of low term grades (below 3.0); however that student remained enrolled in an engineering program and eventually graduated from our university.

Table 1. Program Attrition – Reasons for Leaving Program

Reason for Leaving Program	Count
Changed Major – non-STEM major	3
Changed Major – other STEM major	3
Transferred to Another University	1
Left Program - Poor Academic Performance	3
Left Program – unspecified reasons	1

Program Graduates

Twenty-three program students graduated through December 2011. Twelve of these students are currently employed by major U.S. companies, including Caterpillar, Boeing, INTEL, Micron Technologies, National Instruments, AT&T and L-3 Communications. Of the balance, many are full-time graduate students (7), in military service (1) or working for small engineering firms (3).

Program Demographics

Table 2 provides the demographic data of our awardees in terms of gender, ethnicity, first-generation student and transfer status. Most students fit the "traditional" undergraduate profile of single and under the age of 25 although several students fit the "non-traditional" profile of married with children. It was a program goal to attract students from diverse backgrounds, particularly targeting those with prior military experience or non-traditional background. However, the number of program applicants who fit these categories was very small. It appears that our university's private status coupled with its high tuition costs dissuaded students with prior military service from applying. Twenty-eight percent of the participants were women, which is higher than the national average of less than 20% female the STEM disciplines[14].

Table 2. Scholarship Awardees Demographic Data Fall 2007 through Fall 2011.

Term	Number of Awards	Gender Male/Female	*Ethnicity AF/H/A	First Gen.	*Transfer Status
Fall 2007	8	8/0	0/0/0	1	8
Spring 2008	17	14/3	0/2/0	3	10
Fall 2008	13	10/3	0/2/0	2	8
Spring 2009	12	9/3	0/2/0	3	7
Fall 2009	9	6/3	0/3/0	2	7
Spring 2010	15	12/3	1/1/0	3	9
Fall 2010	10	7/3	0//0/0	2	7
Spring 2011	22	13/9	2/2/1	5	11
Fall 2011	7	4/3	0/0/0	1	3
*Notes: Ethnicity: AF = African American, H = Hispanic, A = Asian. Transfer status > 24 semester hours					

Engineering and Computer Science Retention Data

Data in Table 3 below is an analysis of all our university's students who declared engineering or computer science as their major at some point in their academic career and matriculated starting

in the 2002-2003 through the 2009-2010 academic years. Data in column two represents students who are either currently enrolled or have graduated in engineering or computer science. Data in column three represent students, currently enrolled or graduated, who changed their major from engineering or computer science to another major at this university. Data in column four represents students who left this university without earning a degree. Each column is broken into three categories (rows) which represent traditional freshman who enrolled directly after high school graduation, transfer students who were not in the NSF-SAS program and transfer students who were SAS scholars.

Table 3. Retention Analysis Data - Fall 2007 to Fall 2011.

Type	Egr/CS Current/Grad	Other Current/Grad	Left University	Total
Freshmen	874 56.3%	353 22.7%	326 21.0%	1553
Transfers (non-SAS)	22 38.6%	18 31.6%	17 29.8%	57
Transfers (NSF-SAS)	24 77.4%	2 6.5%	5 16.1%	31

Egr/CS Current/Grad indicates Engineering and Computer Science students who have graduated or are currently enrolled. Other indicates that the students changed their major from Egr/CS and graduated or are currently enrolled. Left University indicates that the student is no longer enrolled.

Rows one and two of Table 3 include student data for five years preceding the SAS program. This historical data was included to insure that actual graduation/retention rates included non-traditional students, many of whom are transfer students. A percentage of these students were part-time or took reduced course loads to accommodate employment required to cover educational expenses.

Chi-Square data analysis was performed using SAS 9.2, and there was a statistically significant difference among the groups ($p = 0.005$). This indicates that the NSF-SAS program had a significant impact on the retention of students who would otherwise have been at high risk or who would not have considered enrollment at our university.

The data shows the following: 1) that the majority of engineering and computer science transfers are participants in the SAS program since its inception in fall 2007, 2) the retention rate for SAS scholars is double that of non-participating transfer students, 3) the retention rate in engineering and computer science for SAS scholars is approximately 50% greater than traditional students who enter as freshmen, and 4) SAS scholars' retention rate approaches that of all students at our university regardless of major, reported to be approximately 84%).

Anecdotal evidence suggests that the scholarship students tended to register for the same section of multi-section courses, and they similarly congregated into the same study groups for these courses. The scholarship students were often seen working together on assignments in the computer lab. During discussions with the students, there were frequent positive comments concerning their level of acceptance and accessibility to the wider University community, the

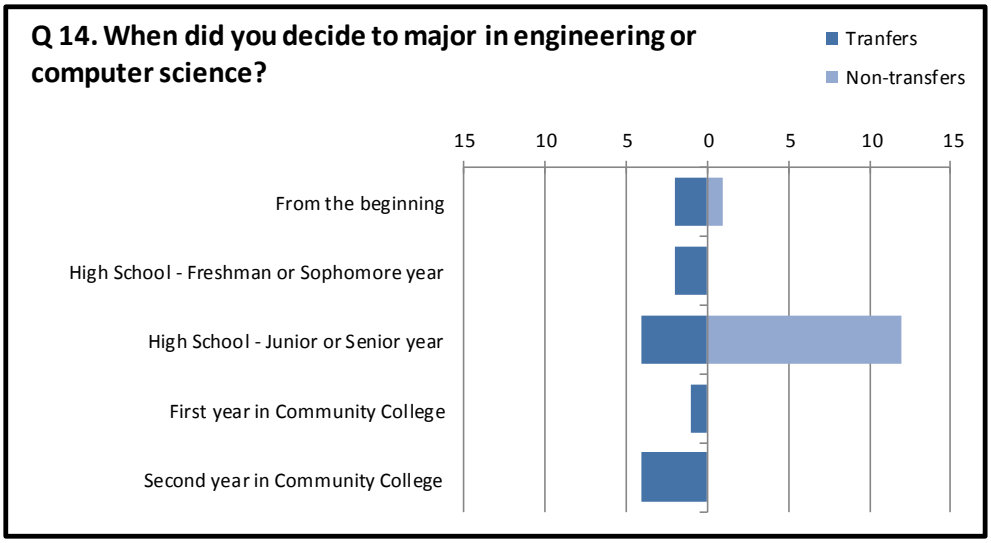
engineering and computer science faculty, student groups, and University services. This was apparently much different than their expectations. Additional anecdotal evidence indicated that these students were more willing to approach the faculty sponsors with questions related to any issues they encountered because of the personal relationships that they had developed with the faculty sponsors.

Student Survey

Of the 54 students who received the survey, 26 students completed it (approximately 47% response rate). The purpose of the surveys was to evaluate the program from the students' perspective. The survey also allowed a comparison of transfer students and non-transfer students in the program. Students are classified as transfer if they transfer more than 24 credit hours to our university. Of the respondents, 13 (50%) were transfer students. Results from 12 of the survey questions are provided below. These results were selected because they show interesting differences and similarities between the transfer and non-transfer students. Also, these results show the views of all the students of the SAS scholarship program.

In Figure 1, a clear difference is shown in the timing of when students decided to major in engineering or computer science. The transfer students were split across all responses, while the non-transfer students mostly chose to major in the last two years of high school. These results may give insight on how to improve recruitment of transfer students.

Figure 1: Decision to major in engineering or computer science.



Figures 2 and 3 reflect student feedback on their understanding of the SAS program's requirements and of the requirements for their major. Traditional students entering our engineering programs are required to enrolling in an introduction to engineering course. This course is designed to help students explore engineering as a career choice. It also includes a significant component related to major requirements, program milestones, course prerequisites and sequencing, advising and registration processes. Many of the SAS transfer students were given credit for this freshman course by substituting credits for courses such as engineering

graphic or other similar technical-oriented instruction. The SAS program helps fill this deficiency for the SAS students.

All regional community college STEM preparation programs follow mandated State curricula which facilitates the transfer of students to four-year STEM programs at State institutions. The mis-alignment between our STEM curricula and the State mandated curricula resulted in the loss of some credit hours when students transferred from their community college preparatory sequence to our STEM programs. Our university is attempting to address this issue but it is still possible that students may lose enough credit that their graduation date is extended by at least one semester.

Figure 2: Responsibilities for the SAS scholarship

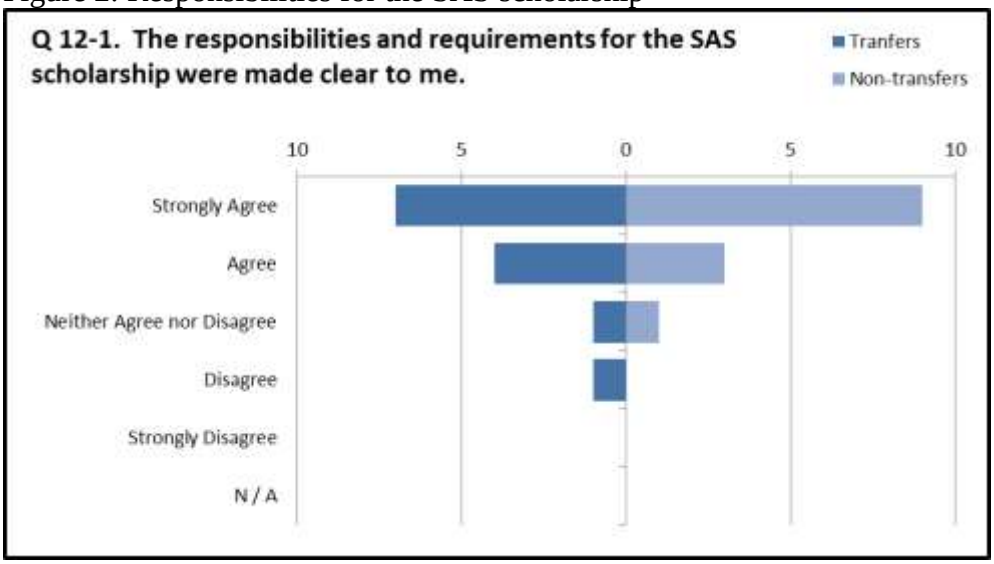
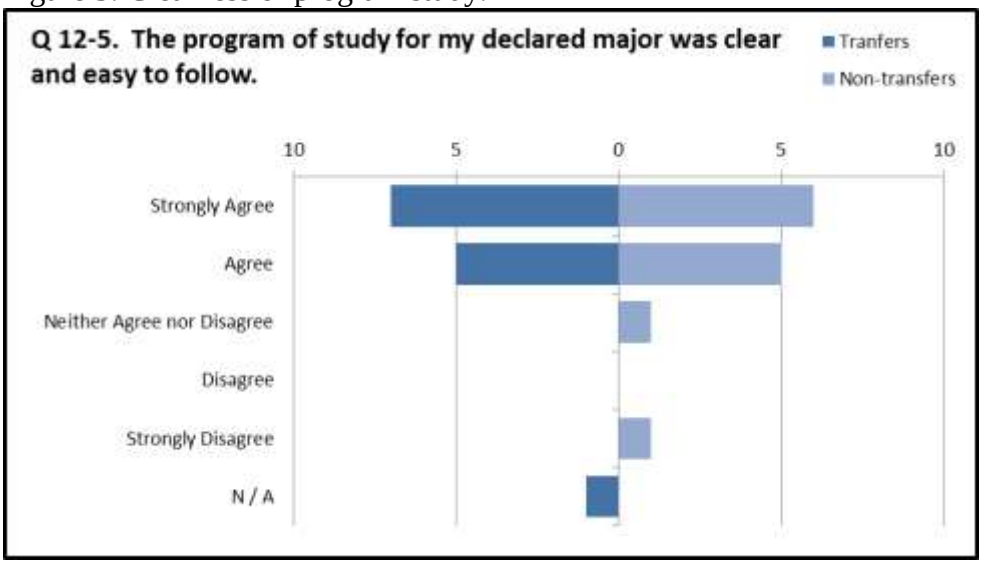


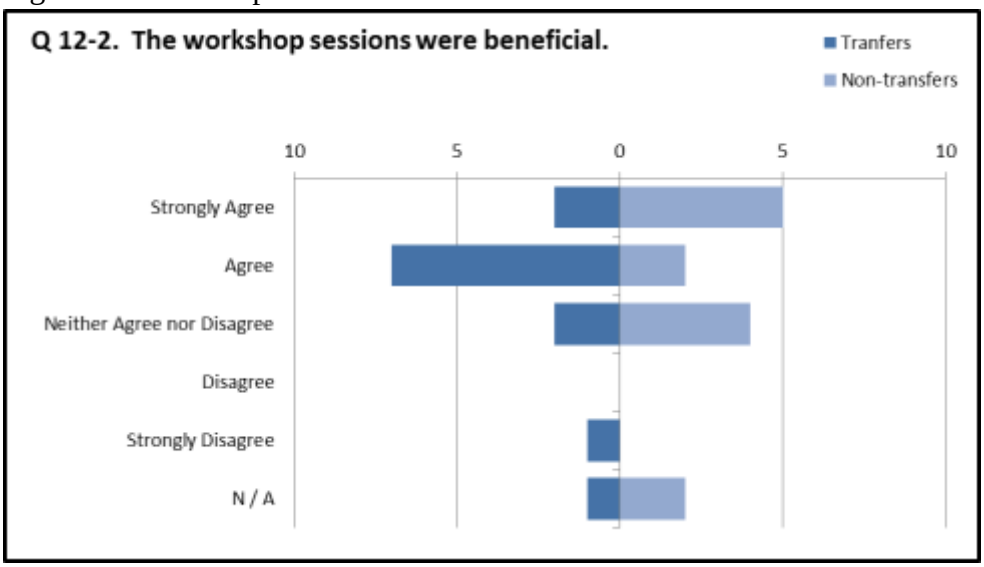
Figure 3: Clearness of program study.



Some of the survey questions asked students about the support structure of the program. Figure 4 shows only one negative response to the question concerning the benefits of the workshop

sessions. These workshop sessions are an integral part of the program objectives so these results are encouraging.

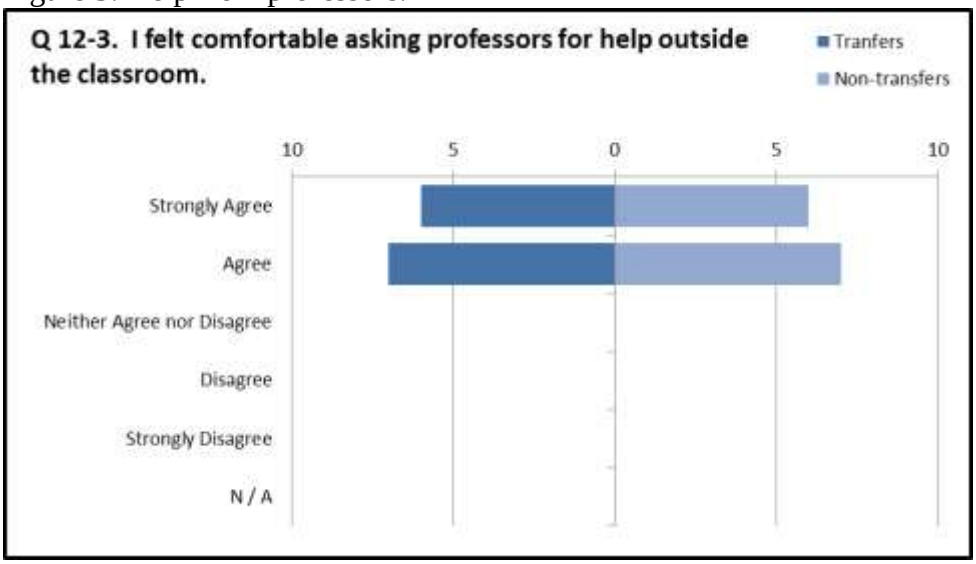
Figure 4: Workshop sessions.



The SAS staff could not provide all the academic support needed for student success. Figures 5 and 6 imply that the academic culture of the engineering and computer science programs as a whole provided an environment that nurtured the success of the SAS students. Certainly, the absence of such support would have detracted from success of the SAS program.

The academic culture of our STEM programs deliver a significant level of student/faculty engagement. The majority of the faculty welcome office visits from students and willingly engage students who need extra academic help. Each student has an assigned advisor who

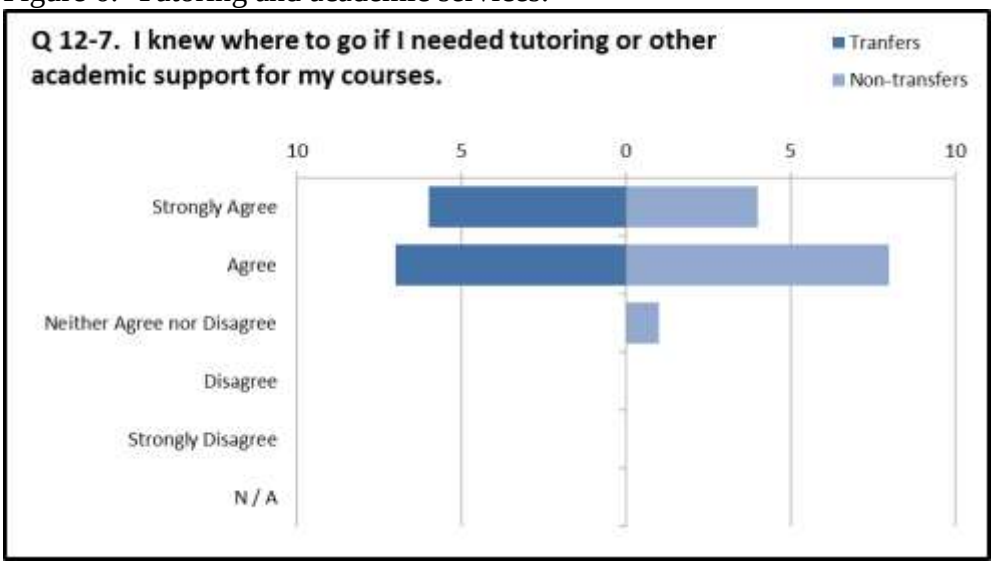
Figure 5: Help from professors.



is responsible for helping the student with next term registration and providing feedback on each student's academic performance. In most cases, the first contact that an advisor has with their assigned students is just past mid-term.

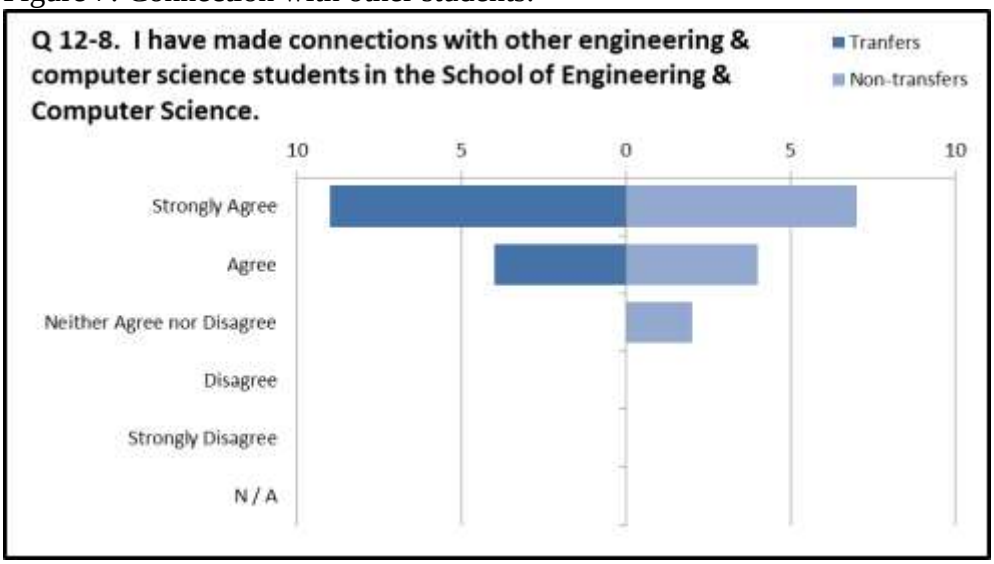
In the case of SAS students, their first introduction to the SAS staff comes before the first day of class. This contact allows the staff to engage the students early in the term and if necessary bring to bear needed resources. It is not operationally possible for the regular faculty to engage students at this level before the first day of class.

Figure 6: Tutoring and academic services.



Transfer students indicated a higher level of connections with other engineering and computer science students than non-transfer students. We found this to be one of the most encouraging

Figure 7: Connection with other students.



results (see figure 7) because the lack of connection with other students was a major issue with transfer students prior to the SAS program.

One of the purposes of the scholarship was to reduce the number of hours per week the student worked. Figure 8 shows that the responses were mainly positive for both transfer and non-transfer students. Figure 9 shows some difference between the two groups in the effect of work on academic success. More non-transfer than transfer students responded that they worked too many hours to perform academically. This result may be due to the transfer students being more accustomed to working a job and attending school.

Figure 8: Reduce number of hours worked.

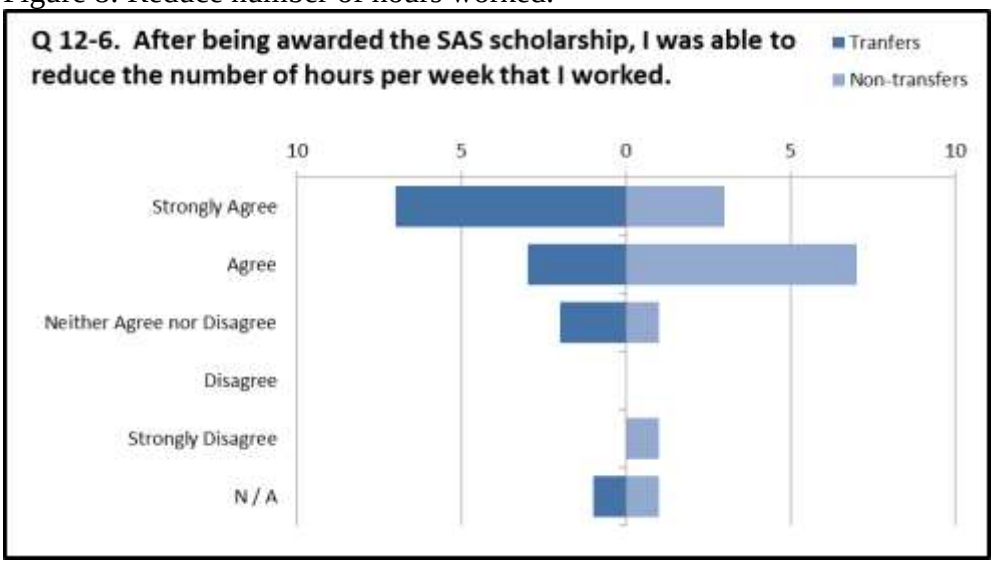
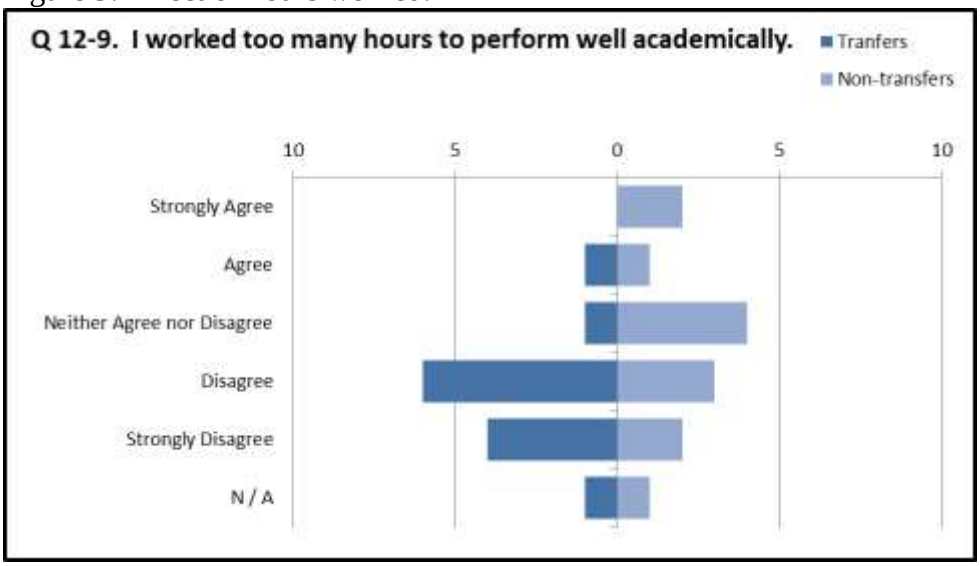
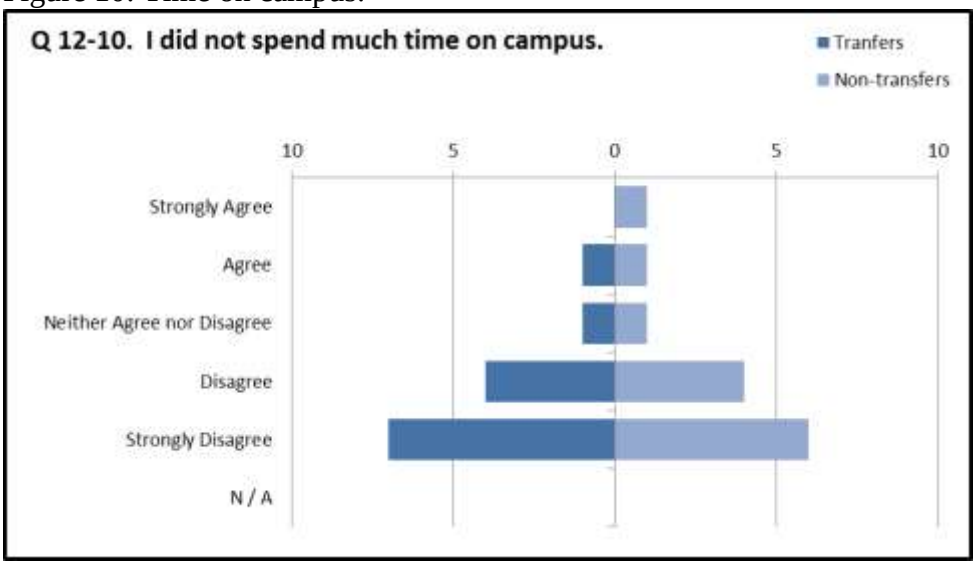


Figure 9: Effect of hours worked.



As initially conceived, the majority of SAS scholars were to live in on-campus residential facilities. The School of Engineering and Computer Science is located amidst a student residential facility that is designed to promote "living and learning engagement." Residency in this facility is a major aspect of our student recruitment policy. Early in the SAS program, it became evident, for various good reasons, that SAS students were gravitating to off-campus housing. Even in light of this fact, SAS students were still engaged in on-campus academic life.

Figure 10: Time on campus:



The overall success of the scholarship program can be measured by the amount of money the students borrowed to complete their degree and on how the students felt the program prepared them for their professional career.

Figure 11: Amount borrowed.

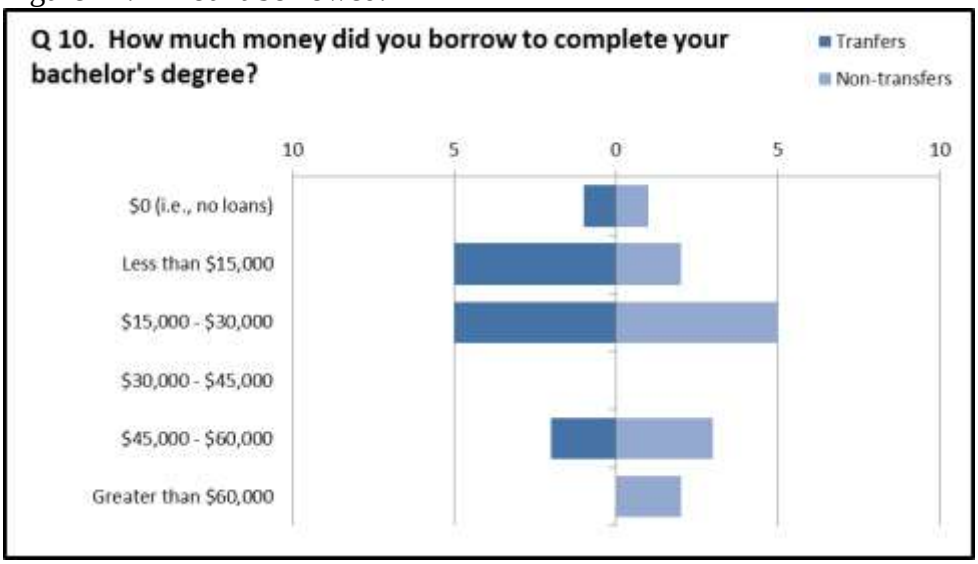
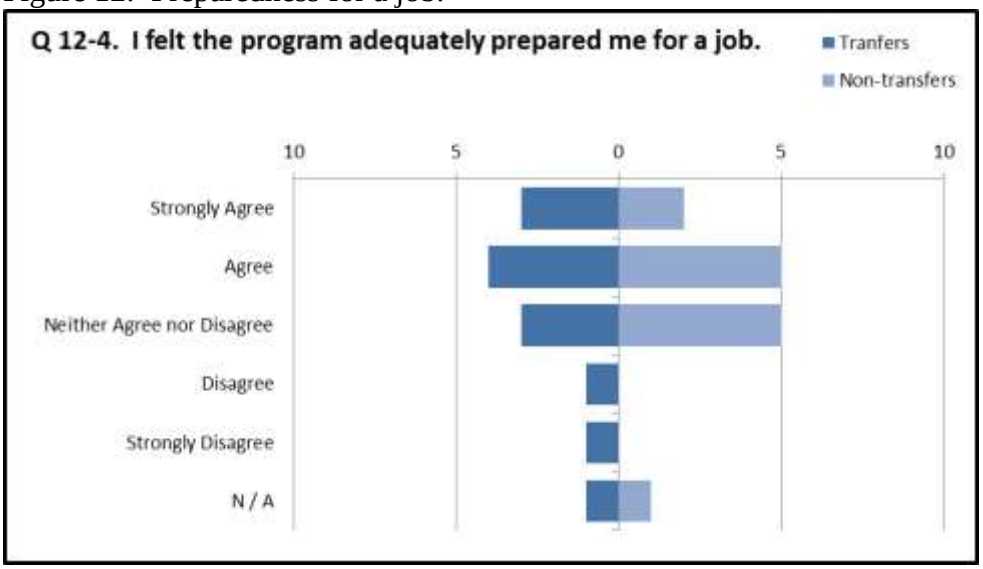


Figure 11 shows the amount of money the students borrowed to complete their bachelor's degree. The majority of the responses were $30,000 or less.

Five of the non-transfer students responded that they borrowed $45,000 or more while two of the transfer students reported the same. This result is not surprising since the transfer students attended two-year colleges with cheaper tuition before transferring to our university.
Figure 12 shows the responses to the question concerning the adequacy of the program to prepare the student for a job. Although there are only two responses that are negative, we would like to see more students responding positively. One possible explanation for the number of neutral responses is that the student may have not graduated yet or they may not have been at a job long enough to make an assessment.

Figure 12: Preparedness for a job.



Findings and Conclusions

From the Retention Analysis Data of Table 3, clearly the SAS program was a success for the greater number of transfer student than might have been the case if the program had not been available. The SAS program targeted specific areas of concern that had been previously identified by researchers, and the results were strikingly positive for those students who were successful in completing the program. Even though the program implemented many of the known best practices, there was still a large portion of students who dropped from the STEM program or who failed to achieve their academic goals. Some part of the attrition can be attributed to the "normal" erosion experienced by all STEM programs as students become disenchanted or lose interest and change to a non-STEM major.

There is at least anecdotal evidence that a contributing factor to a student's failure or success can be attributed to their initial community college experience. As a whole, students from two regional community colleges did significantly better than students from other schools. Of particular note were their strong mathematics programs. In fact, most of the engineering or computer science students recruited from these schools indicated mathematics as their academic major. The students recruited from other schools were less focused in terms of specific academic interests.

The scholarship awards made a significant difference for the majority of students in the program. The SAS program gave the students a sense of success and accomplishment that was lacking in their previous academic experience. These students were non-traditional in the sense that they did not follow their high school cohort directly to a 4-year college experience. Rather they took an indirect route and chose to enter the workforce and attend their local community college as a part-time student. This route leads to a much smaller vision of the academic universe which makes the transition to a four year STEM degree program much harder than would normally be the case.

The academic services provided to the SAS students were much more focused than commensurate services provide to most STEM students on campus. The university has had a significant retention program in place for the last 8 years in an attempt to raise the retention rate of the university as a whole. The University programs are staffed by professionals with educational backgrounds in academic support services and student engagement, and there are many best practices elements to their programs. While these programs have been successful in raising the retention numbers, the SAS program had a significantly better track-record. The reasons appear to be related to the active participation of faculty with STEM backgrounds and with the level of student/faculty engagement provided to SAS students . Most of the successful SAS transfer students were recruited well in advance of their appearance on campus, and in some cases were provided academic advisement during their last semester of community college work. This contact provided a bridge from their community college experience to our STEM programs. Early advisement reduced the number of credit hours a student lost in the transfer process, guided students into community college courses that strengthened their mathematics backgrounds, provided the students with a STEM mentor, and enabled many students to complete their degree programs in the shortest time possible.

We believe that this program's success warrants continuation, and we will be pursuing funding to continue this program and to extend our expertise into additional aspects of best practices to increase STEM enrollment in the School of Engineering and Computer Science.

Acknowledgement

This material is based upon work supported by the National Science Foundation under Grant No. 0630943.

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