



Lessons Learned from an S-STEM Grant

Dr. Ricky T. Castles, East Carolina University

Dr. Ricky Castles is an assistant professor in the Department of Engineering at East Carolina University. He is primarily affiliated with the ECU Electrical Engineering concentration. His research work focuses on the use of wireless sensor networks, microcontrollers, and physiological data collection for a variety of applications. He is also interested in engineering education research including leadership development, broadening participating, and opportunities for first generation college students.

Dr. Evelyn C. Brown, North Carolina State University

Dr. Brown is Director of Extension Research and Development at North Carolina State University. She works for Industry Expansion Solutions, the extension arm of the NC State College of Engineering. Most of her research is in the area of applying industrial engineering techniques to health care process improvement. However, she also does research in the area of STEM education. Dr. Brown has published education-related research in *INFORMS Transactions on Education*, *Proceedings of the 2009 ASEE National Meeting*, and *Proceedings of the 2008 ASEE Southeast Section Meeting*. While working at East Carolina University, she was PI on an NSF S-STEM grant in the amount of \$599,894.

Lessons Learned from an S-STEM grant

The engineering department at East Carolina University (ECU) completed a 6-year S-STEM grant project in 2017. In this poster, the successes and shortcomings of this project are presented and evaluated. Issues addressed include appropriate levels of funding for incoming freshmen and recommendations of funding levels for upperclassmen, along with incentive bonuses for significant academic achievement. Cohort size is discussed, along with the complications of drawing significant research conclusions from small cohorts. A job-shadowing experience is discussed, along with lessons learned about the selection of appropriate personnel for shadowing partners. Issues of student compliance with scholarship terms including continued enrollment in a STEM major, maintaining a minimum GPA, and meeting academic progress standards are discussed, as are the lessons learned from working with the university financial aid office to ensure proper implementation and distribution of the scholarship funds and removal of funds from student accounts for students no longer satisfying scholarship terms. Social activities and professional development opportunities are discussed, with recommendations for improvement of these activities for future projects. The poster also introduces ways to better communicate to students the opportunities the grant funds may provide beyond scholarship funding, such as opportunities to attend professional conferences.

Scholarship Awards and Eligibility

The funding provided by the S-STEM grant was primarily used to provide scholarship funds for four cohorts of engineering majors. In the 2011-12 academic year, a small cohort of freshmen students at ECU were supported by scholarships. The first cohort contained six students and each year a new cohort of approximately six students was selected from the newly entering class of freshman students. Students were required to be eligible for financial aid per the FAFSA requirements, be residents of North Carolina and be accepted for admission to the engineering program. Enrollment peaked in Fall 2014 with a total of 22 students supported by scholarships during that semester, including five seniors, seven juniors, five sophomores, and five freshmen. In subsequent semesters, new cohorts were not brought in, but those in the program continued to be supported until the 2017-18 academic year when two seniors remained in the program.

Scholarships were awarded in the amount of \$5,000, \$7,500, or \$10,000 per year depending upon demonstrated need and academic record. In order to renew their scholarship award in subsequent semesters, students were required to maintain a minimum GPA of 3.0 and continue to make satisfactory academic progress toward a degree in engineering. If students failed to meet the GPA requirement, they were given one semester of probation and if they continued to have low academic performance, their scholarship was removed. If a freshman was removed from the program, an eligible student not currently receiving a scholarship was selected from the same graduating class as the cohort of the student being replaced, meaning that some students were supported for up to four years by the scholarships and others were only supported for a maximum of three years.

Program Results

In total, 28 students have been supported by this grant. Of those 28 students, 18 graduated with a Bachelor of Science in Engineering (BSE) and another 3 are expected to complete their BSE by the end of 2018. One more student was on track to complete a BSE, but was tragically killed in a car accident. Three students dropped out of college due to poor academic performance and three students changed their major out of engineering.

Among the 18 graduates, 12 maintained academic eligibility to retain their scholarship from their entrance into the scholarship program until they graduated. Three additional students maintained their academic eligibility for four years, but left the program after having been funded for the maximum number of semester they could be supported. These students graduated within five years. Four students who lost their scholarship due to poor academic performance still completed an engineering degree. Of all students who were supported by S-STEM scholarships in engineering at ECU, 75% earned or are expected to earn a BSE within five years.

Recommendations on Funding Levels

For the most part, this scholarship program set a funding level for a student and then maintained the same level of funding for the entire duration of that student's time at the university, as long as they maintained a 3.0 or higher GPA. In some cases, this resulted in significant expense of funds for freshmen who did not perform well academically and ended up dropping out of college, or students who were not committed to engineering studies and ended up changing their major. In the future, it is recommended that smaller scholarship funds be dedicated to freshman, with opportunities to increase scholarships for upperclassmen with excellent academic records. It is also recommended that there be some financial incentive in the scholarship award for students who greatly exceed the minimum requirements such as increasing the scholarship award for students who maintain greater than a 3.5 or perhaps 3.75 GPA. It is recommended that PIs work closely with the financial aid office at the university to determine appropriate scholarship levels to help recruit students to the program while ensuring that a significant number of students can be impacted.

Working with the University Financial Aid Department

One of the strengths of this program was the relationship developed between the engineering department and the director of scholarships and the director of financial aid. As students progressed through the program, ensuring that their scholarship money was deposited into their student account in a timely manner was critical. It was also quite important at the end of the grant program to ensure that students would have the appropriate level of aid for their entire year even though the grant funds were ending December 31. This relationship was also very helpful in removing scholarship funds from students who failed to maintain eligibility and inserting replacement students to take their place.

Inaccessibility of Funds by Transfer Students

At ECU there is an increasing trend of more students coming to the university after completing two years at a community college instead of coming in as freshmen straight out of high school. In this S-STEM program, students could only receive scholarship funding if they came to the university as freshmen. A team at this university is planning to submit an S-STEM proposal to build on the results of this grant that will include funding opportunities for students who start their engineering studies at ECU and students who elect to begin their engineering studies at a community college. Currently 23% of seniors scheduled to graduate from the engineering program at ECU in either May or December 2018 began their college experience at a community college. It has been observed that transfer students tend to be more mature than many of the students who started as freshmen and have a very strong work ethic. This makes transfer students, who have proven they are capable of completing college course for two years, less risky investments for scholarship funds. In the 2015-16 academic year, 49% of bachelor's degree recipients had been previously enrolled in two-year public institutions [1].

Social and Networking Opportunities

One of the important parts of retaining students is developing a sense of belonging. A small portion of grant funds was used to provide social activities for scholarship students such as bowling nights and trivia nights. Additionally, a few other departments on campus were also funded with S-STEM grants and social activities were planned to allow engineering S-STEM students to interact with S-STEM students in chemistry and biology such as trivia competitions. After the first two cohorts graduated, the PI took some of the students out to dinner using personal funds to continue to build a sense of community and to communicate that the faculty cared for the students.

Each semester, S-STEM scholarship recipients were invited to join the Department of Engineering Advisory Board for a lunch during their biannual meetings. This gave students the opportunity to meet professionals in a variety of engineering jobs, find out about opportunities available for jobs and internships, and practice their interviewing skills in an informal setting.

Job Shadowing

Observing is a very effective way to learn[2]. One of the most appreciated activities sponsored by the S-STEM grant was job shadowing. The PI team contacted several alumni and members of the department advisory board seeking partners to allow the scholarship students to spend a half day shadowing them to see what working in the engineering field is like on a day-to-day basis. The goal of this activity was to inspire students to continue to pursue their goal of obtaining an engineering degree by showcasing the many opportunities available to them as engineers. It was also a goal of this activity to help students make informed choices about which job opportunities they would pursue after graduation.

In the first year, advisory board members were selected as shadowing partners. It was quickly determined that this group was not the best fit for shadowing partners. Many members of the advisory board are in more senior level positions within their employers and are often removed

from the activities of entry-level engineering work. Several of these board members are in management positions, and are no longer directly involved in engineering work. Also, some board members are involved in confidential company meetings and this precluded allowing students to shadow. It was a far better fit to allow students to shadow young alumni. This allowed students to see the work being done by entry-level engineers. Shadowing young alumni also allowed the students to see a role model in an engineering career who is not much older than they are. This allowed the students to see becoming an engineer as a realistic, short-term goal.

Students Losing Scholarship Eligibility Does Not Mean the Scholarship Program Was Unsuccessful

Three students who received scholarship funding lost their funding due to no longer meeting the minimum academic requirements and continued to be enrolled in the engineering program until they obtained an engineering degree. Additionally, another three students who were funded by an S-STEM completed an engineering degree despite degree completion taking more than four years. Only three of the 28 funded students lost scholarship funding and ended up dropping out of the university without completing any degree. The support students received, whether it was for all four years or just one year, helped students along the path to completing a degree.

Cohort Entering Fall 2011

The first cohort of scholarship supported students entered ECU in the Fall 2011 semester. Six students in this cohort began receiving scholarship funds in their first semester studying engineering and one student was selected as a second year student in Fall 2012 to replace a member of this cohort who lost eligibility after the first year. Among scholarship supported students in this cohort, 71.4% (5 out of 7) completed engineering degrees compared with only 47.6% of students who entered the engineering program at ECU as freshmen in the same year. One student changed his major to a non-STEM field and graduated with a non-engineering degree and one student dropped out of college without a degree.

Cohort Entering Fall 2012

All of the scholarship supported students who began as freshmen engineering majors in Fall 2012 have completed engineering degrees. This included three students who completed an engineering degree in four years and retained scholarship eligibility for all four years, three students who maintained their scholarship eligibility for four years and took an extra semester or year to complete their degree, and two students who lost scholarship eligibility due to low academic performance who still completed an engineering degree. This is far better than the 52.7% of all engineering freshmen entering in Fall 2012 who have completed a degree in engineering.

Cohort Entering Fall 2013

Among the cohort of engineering majors starting as freshmen in Fall 2013, three students who started receiving scholarship support as freshmen completed engineering degrees within four years and maintained scholarship eligibility over that time period. One sophomore replacement student maintained eligibility for three academic years and graduated four years after beginning

engineering study. One student changed to a non-STEM major after one semester and one student dropped out of college. Another student was selected as a second-semester freshman to replace the student who changed to a non-STEM field and despite losing scholarship eligibility, still complete an engineering degree.

Table 1 Cohort Graduation of scholarship supported students and overall

Cohort Entering Year	% of S-STEM Students completing an engineering degree (by Spring 2017)	% of Admitted Freshmen completing an engineering degree (by Spring 2017)
2011	71.4%	47.6%
2012	100.0%	52.7%
2013	60.0%	34.7%

Drawing Conclusions with Small Cohort Size

With only approximately six students in each graduating class cohort, it was difficult to do quantitative analysis of retention and persistence. The best way to analyze the success of the program was through qualitative analysis of discussions with the students. The scholarship supported students graduated at a much higher rate than their peers, with 75% of all scholarship supported students earning or projected to earn an engineering degree in the next year. Only three of the 28 scholarship supported students changed their major away from engineering (10.7%). Nation-wide 33% of bachelor's degree students change their major at least once with 9% of students changing their major two or more times. The major students start in has a significant impact on whether students choose to change their major and 35% of students nationwide who begin a major in a STEM field change their major before they graduate including 32% of engineering and technology majors [3].

Communication with S-STEM Students

S-STEM scholarship students were invited to several meetings throughout the semester. These meetings were primarily designed to check in with the students to ensure they were doing well academically and to keep them apprised of upcoming events on campus such as career fairs. These meetings also helped to get students together so they could form friendships and study partners with their cohort peers. During the meetings, the PI team ensured that students were properly able to register for class, their financial aid came through properly, that classes were going well and they were not having issues with any professor, and worked to establish a schedule for job shadowing.

Conclusions and Acknowledgements

This S-STEM program was successful in helping fund 21 students who either have or are projected to graduate with a BSE in the next year. Job-shadowing was a very beneficial portion of this program and enable students to see the work being done by professionals in the field and to build their network of professional contacts. It was important to note that the selection of appropriate shadowing partners strengthened this program as students received a better

experience shadowing young alumni than more senior board members. This program taught us that investing in freshmen is sometimes a gamble as the aptitude demonstrated by high school students is sometimes not exhibited by college freshmen away from home for the first time with new freedoms. Generally, if students were successful in maintaining their scholarship eligibility throughout the first year, they did graduate with a BSE. A few students who lost scholarship support over the course of four years were still successful in completing a BSE, so the program was beneficial to more students than just those who were supported for all four years. Sophomore replacements selected from the highest performing freshmen engineering majors were very successful in completing the BSE program and sets a precedent that future S-STEM programs may want to reserve some funds for students who may not have been initially selected as scholarship recipients as freshman, but who have demonstrated significant academic success in the first year.

References

- [1] National Student Clearinghouse Research Center “Snapshot Report- Contribution of Two-Year Public Institutions to Bachelor’s Completions at Four-Year Institutions” March 29, 2017
- [2] A. Bandura, and R. Walters (1963) *Social learning and personality development*. Holt, Rinehart, and Winston, New York.
- [3] U.S. Department of Education “Data Point Beginning College Students Who Change Their Majors Within 3 Years of Enrollment” NCES 2018-434 December 2017