



The Impact of Federally Funded Scholarship Programs on the Success of Transfer Students at a Public Engineering College

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Abstract

Nationally almost half of the students receiving baccalaureate degrees in science and engineering complete part of their education at a community college, and this statistic is expected to increase with the rising costs of attending a four-year public institution. The demographics of almost all four-year engineering programs fail to align with U.S. Census data for women and under-represented minorities. Community colleges, on the other hand, serve a high number of these students. Programs designed to support community college student transition and graduation from four-year engineering programs will naturally increase the pipeline of diverse students entering the workforce.

This paper will review the impacts of two National Science Foundation S-STEM (Scholarships in Science, Technology, Engineering, and Mathematics) grants on undergraduate minority engineering transfer student retention and development during the period 2007-13 in the College of Engineering at the University of Massachusetts Amherst. The programs were designed to overcome known barriers to persistence of transfer students from community college, including lack of engagement on campus, underdeveloped professional work ethic and goals, deficient study habits, fewer opportunities to gain practical competence/reflection on learning, and working for pay. The elements of the programs included cohorting, team-building, mentoring, tutoring, and advising, as well as monetary support in the form of scholarships. Compared to control groups, the cohorts participating in these programs showed significantly higher retention rates, a shorter time-to-degree, and higher placement rates in industry or graduate school. The College also experienced an increase in diversity and an expanded pipeline of students continuing on to graduate school. Key elements of the programs that lead to success will be highlighted and the challenges for attaining sustainability discussed.

Introduction

The College of Engineering (CoE) at the University of Massachusetts Amherst received two “Scholarships in Science, Technology, Engineering, and Mathematics” (S-STEM) grants from the National Science Foundation (NSF) over the period 2007-13. Both grants focused on recruiting, retaining and graduating economically disadvantaged engineering transfer students; the second also introduced an emphasis on recruiting previous S-STEM Scholars into graduate programs within the CoE. Specific programs were designed to address known barriers to success in the target population. Through detailed student tracking, we were able to compare two summative metrics of academic success (graduation and job placement rates) between the S-STEM Scholars and the total transfer student population of CoE. Also, through a survey given to the Scholars annually, we were able to identify which S-STEM program elements were the most valued and utilize this insight for the design of future programs.

Program Elements

Funding. Two NSF S-STEM grants, with total funds in the range of \$600,000 each, were received in succession. The first one, DUE-0728485, covered the period 2007-2013 (including a no-cost extension); we will refer to this as Grant #1. The second one, DUE-0965783, covered

the period 2010-2013; we will refer to this as Grant #2. The vast majority of funds in both grants were allocated to student scholarships, with roughly 10% allocated to administrative and student support services, as required by NSF guidelines. These administrative and support funds were used to fund many of the program activities described below.

Populations. The program participants, referred to as S-STEM Scholars, were selected from the pool of transfer students who met the following qualifications: U.S. citizens or permanent residents, enrolled full-time in one of majors within CoE, demonstrate academic potential or ability, and demonstrate financial need (as defined by the US Dept. of Education rules for federal financial aid and implemented by the university's financial aid office). Grant #1 supported 39 undergraduate students; 18% were female, 28% were members of an under-represented minority (URM) group, and one reported a disability. Grant #2 also supported 39 students; 18% were female and 39% were URM.

Scholarships. S-STEM Scholars typically received two years of scholarship support in the amount of \$8,000 per year. Continued support beyond two years was possible, subject to a review of academic progress and financial eligibility. Some students were offered less than two years of support due to limited availability of project funds near the end of a grant period, and a small number of students left the program.

Activities. All S-STEM program activities were run or coordinated through the CoE's Events Office with assistance from the Diversity Programs Office (DPO). The mission of the DPO is to provide academic and non-academic support to increase enrollment, retention, and graduation among under-represented minorities and women, but DPO services are available to all CoE students. The DPO collaborates with the university's Learning Resource Center (LRC) to provide academic support services and essay writing support for scholarship, graduate school, and similar applications. The DPO also provides professional development workshops and networking events for students to interact with industry, alumni and faculty, and runs a robust K-12 outreach program.

Our activities were designed to overcome known barriers to persistence for our target population. *"Compared to students who began and persisted at a single four-year institution, students who transferred to a four-year institution from a two-year institution tended to have fewer interactions with faculty and fewer educationally enriching activities such as internships, community service, and senior capstone courses".¹ Academic and career development support for the S-STEM students will shift with their needs. As noted by Dr. Shirley Ann Jackson, "...we have to meet the students where they are: we have to give them personal attention. Programs that are structured this way see the value of personal attention at every stage of higher education and are committed to meeting students' individual learning needs, which includes mentoring and tutoring".² Through our work with two S-STEM cohorts, we have identified early and intensive involvement of the S-STEM students with faculty and staff advisors as an integral part of a successful program. Other program elements we believe to be important are summarized in Table 1, organized by the five known barriers to persistence on which we focused. It should be noted that some of these elements were in place during Grant #1 and #2, while others are proposed initiatives for future S-STEM cohorts.*

Engagement/Belonging. The Associate Dean for Student Affairs of the CoE and additional professional staff members met formally with the Scholars once a semester, providing an opportunity for students to talk about any issues as well as to learn about opportunities. In addition to providing basic program updates, these meetings facilitated peer-to-peer support amongst the Scholars. Proposed enhancements for “all hands” meetings include additional professional networking events to provide the S-STEM Scholars an opportunity to interact with faculty, upper-level undergraduates, and graduate student mentors in a more relaxed, informal environment. We believe that this meeting in a low-stakes environment leads to greater understanding of each student’s background and needs. In practice the professional staff saw students regularly in the DPO, which functions for students as a friendly, informal place to study, connect with peers and advisors, or simply relax. With such support immediately available, problems in transitioning (housing, financial aid, course selection, building study networks, etc.) and feelings of isolation³ are addressed more quickly. Another proposed enhancement is to assign each Scholar one of the co-PI or senior personnel on the S-STEM grant as their faculty advisor; these faculty are more aware of the unique issues facing URM students and will be able to provide more targeted one-on-one academic advising each semester.

Barriers	Activities
Lack of Engagement/Sense of Belonging	<ul style="list-style-type: none"> - Personal academic advising by faculty - Meetings with DPO Director - All hands meetings
Deficient Study Habits	<ul style="list-style-type: none"> - Study groups - Free tutoring and study jams - Supplemental Instruction (SI) sessions
Underdeveloped Professional Work Ethic & Goal Setting	<ul style="list-style-type: none"> - Peer mentoring - Career development workshops
Insufficient Opportunities to Gain Practical Competence & Reflect on Learning	<ul style="list-style-type: none"> - National conference participation - Research and internship opportunities
Working for Pay	<ul style="list-style-type: none"> - S-STEM scholarship - Personal financial aid advising

Table 1. S-STEM Scholars program activities organized by the barrier each aims to overcome

Study Habits. While past Scholars had access to free academic support services, they did not always choose to utilize these resources. We provided the Scholars with detailed information about free tutoring and supplemental instruction (SI) resources on campus; most of these activities were offered through the Learning Resource Center (LRC). The SI program employs a peer-to-peer learning model, in which a student who has previously been successful in a course receives pedagogical training from the LRC and serves as an SI Leader, offering regular review seminars to students currently enrolled in the course. The CoE and DPO provided additional resources to the LRC to increase the number of difficult lower-level engineering courses covered by SI Leaders. In the future, we plan to require Scholars to participate in one of several weekly study groups during their first semester on campus (in subsequent semesters, participation in the study groups will be optional). The study groups will meet in the DPO, which has study space available and can be accessed after hours. The first semester study groups will help develop a

cohort among the scholars as well support them in the development of good study habits through targeted workshops and referral to other sources of support as needed.

Work Ethic & Goal Setting. Another future strategy is to enhance existing undergraduate mentorship programs within the CoE. For example, our student chapter of the Society of Women Engineers (SWE) currently runs a mentoring program that pairs freshmen women with a junior or senior in their major. The mentors and mentees meet at their discretion; currently there are no formal guidelines, structured events, or training for the mentors. In 2012 (the second year of Grant #2) we began a collaboration with a researcher on campus to study whether the mentor's gender influences the female engineering mentees attitudes toward engineering, identification with the discipline, self-confidence, persistence rate, and career goals. The CoE assisted with student recruitment for this study, which in 2012 and 2013 involved almost the entire cohort of first-year and transfer engineering women. Before mentors began interacting with mentees, all mentors underwent a focus group and training. Part of this training involved teaching mentors to highlight to their mentees the importance of taking advantage of relevant research and career development opportunities early in their undergraduate careers. While the research is incomplete and data analysis is ongoing, there are some initial interesting results that suggest that female mentors have a more positive impact on younger female students' motivation to pursue an engineering career post-graduation compared to male mentors. The CoE is working on formalizing a mentoring program that will be offered to all freshman and transfer students starting in Fall 2015.

Practical Competence/Reflection on Learning. Our past efforts to address this barrier have focused on providing Scholars the opportunity to attend local, regional and national professional and technical conferences. This aspect of the program was intended to broaden the horizons of Scholars by: (1) emphasizing the importance of networking with peers, faculty, and professional engineers around the country, (2) providing exposure to cutting-edge research and technology, and (3) providing access to wider graduate school and job opportunities. A large fraction of the "student support services" portion of the budget was allocated to this activity. In addition, we encouraged the Scholars to participate in professional development workshops provided through the Engineering Career and Student Development Center (CSDC) in the CoE.

In the future we will employ a three-pronged approach to overcome this barrier by focusing on professional development, K-12 outreach, and community engagement.

We plan to partner further with the CSDC to offer professional development workshops customized to meet the needs of the S-STEM Scholars, rather than asking them to attend sessions open to the full CoE. These workshops will start with the basics of how to get research experience on campus and progress to off-campus REUs and internships and ultimately the search for a post-graduation position. While we cannot guarantee a research experience or internship for every Scholar, we will continue to emphasize the importance of these activities on their career path and provide them with more personalized assistance to identify and apply to specific opportunities.

In the future we also will provide all interested S-STEM Scholars with opportunities to participate in K-12 outreach. The DPO actively engages undergraduates and faculty in designing outreach activities that are age level appropriate, but utilize cutting edge engineering concepts.

Participation in outreach events will give S-STEM scholars an opportunity to in turn be mentors to middle and high school students who are beginning to formulate career and college plans.

Working for pay. Our intent was to award a scholarship large enough to have a significant, positive impact and to mitigate the need to work. An \$8,000 annual scholarship was more than 30% of the total annual cost of tuition, mandatory fees, room and board for an undergraduate in-state student in the College of Engineering at the University of Massachusetts Amherst. Paired with the financial aid and other financial support programs, this covered the educational costs of most transfer students. We also offered personalized financial aid advising to all Scholars.

Research Questions, Assessment, and Outcomes

We describe the assessment and outcomes related to each of two basic questions.

- Does an S-STEM program with the elements described above, increase retention and placement rate?
- What specific elements of our S-STEM program were most effective?

Retention and Placement. The retention and placement numbers for the Grant #1 and Grant #2 cohorts are given in the middle columns of Table 2. In the Grant #1 cohort, 39 undergraduate students were supported and 35 graduated; retention within CoE was 87% for this group (one of the students graduated from a major outside of CoE). Currently 83% of this cohort is employed or in graduate school. In the Grant #2 cohort, which included graduate students, 39 students were supported and 27 graduated within CoE; two additional undergraduates are still expected to graduate and four graduate students are still active in their graduate programs (2 MS, 2 PhD). Retention within CoE was therefore reported as 85% for this cohort. Currently 85% of this cohort is employed or in graduate school.

Comparative numbers for the general transfer student population in CoE are given in the last column of Table 2. For transfer students entering CoE in the years 2007-09, the four-year graduation rate is between 61 and 64%. The S-STEM Scholars graduated at rates that were more than 20% greater. For transfer students graduating in academic years 2012-13 and 2013-14, the placement rates were 80% and 77% respectively. The placement rates of the S-STEM Scholars were higher in each case, although the difference between the Scholars and the general population is significant (*i.e.*, greater than the typical year-to-year fluctuations) only for the Grant #2 cohort.

	S-STEM cohorts		All CoE Transfer Students
Transfer student graduation rate in engineering	87%	Grant #1	61 – 64% after 4 years in CoE (transfers entering 2007, 2008, 2009)
	85%	Grant #2	
Placement upon graduation (grad school, industry)	83%	Grant #1	80% (2012 – 2013 data)
	85%	Grant #2	77% (2013 – 2014 data)

Table 2. Graduation (within engineering) and placement rates for the S-STEM cohorts, as compared to those for all transfer students entering the College.

Effectiveness of Program Elements. A survey specific to the S-STEM program was developed for Grant #2. Questions addressed specific numerical quantities like hours worked for pay and hours spent preparing for classes, as well as the opportunity to provide free-form comments on the program.

We report on the results obtained in academic year 2011-12, since those are the most complete. A total of 22 Scholars received the survey request in the fall semester, with 19 completing and returning it; a total of 20 Scholars received the survey request in the spring semester, with 19 completing and returning it. Percentages or numbers reported below are averages of the results across the two surveys. This section is organized by the same barriers to persistence that we described above.

Engagement/Belonging. The Scholars gave several free-form responses relevant to this barrier.

“The S-STEM Program did not only provide me with financial assistance, they helped me with connecting me to faculty personnel, providing academic services and incredible advice from *name deleted*. I greatly appreciate this program.”

“The S-STEM program and scholarship is an impressive program that comes to the help of students that are able to maintain a good grade point average in their academic career. On top of the amazing opportunity it offers, it comes in with a lot of help maintaining the morale of the students and offers help academically as well as through a variety of tutoring helps and career fairs that sometimes can lead to an opportunity of employment. The S-STEM program has helped me in various ways and one of the reasons why I am still standing and continuing is S-STEM.”

“The program really helped me out this semester financially and allowed me to focus more time towards my school work. Also, being part of the S-STEM, faculty encouraged me to continue to try my hardest.”

Study Habits. Of the responding Scholars, 98% reported spending 16 or more hours per week preparing for class, while 62% reported spending more than 21 hours per week. 49% reported using tutoring resources through the LRC, while 41% reported using tutoring services provided within the DPO space. Several gave relevant free-form responses.

“Also knowing that there is tons of support for me to understand my classes to the best of my ability is something that puts a lot of ease in my mind regarding whether or not I’ll be able to make it to the end of this program.”

“The S-STEM program has no equal. Not only does it help students financially, but academically as well. It is formed of well-organized staff that are there and always available to help students with their daily need of help with the major. I think the program is amazing.”

Practical Competence/Reflection on Learning. Of the responding Scholars, 40% reported utilizing resources in the Career and Student Development Center. One Scholar noted financial support that specifically assisted with professional development.

“The S-STEM program is the best thing that happened to be since I transferred to UMass. It provided me with scholarship, advising, academic support and even paid for my trip to a national conference!”

Working for pay. Of the responding Scholars, 87% reported not working at all or working less than 10 hours per week. This aspect of the program was reflected in almost every free-form response, with several making it the main focus.

“The S-STEM program and scholarship has relieved me of a lot of stress. I was worried about having to work during the semester but the S-STEM scholarship let me focus on my studies.”

“I’m very thankful that I was chosen to be part of the STEM program. Without it I wouldn’t be able to financially handle college.”

Conclusions

Two S-STEM grants from NSF allowed the College of Engineering at the University of Massachusetts Amherst to offer scholarships and support activities to almost 80 engineering transfer students, known as S-STEM Scholars, over a recent six-year period. The four-year graduation rate of the Scholars was significantly higher than that of the general population of transfer students during the same time frame. The job placement rate was also higher for the Scholars, although the difference was statistically significant only for the cohort supported by the second grant. Many of the support services designed for the Scholars, were also open to the entire engineering student population. A regular survey helped us to identify effective elements of the S-STEM program. The scholarship funds were critical in helping Scholars to reduce their weekly hours spent on work-for-pay below 10 and thus boost their hours spent on studying above 15. Program elements providing academic support (tutoring) and professional development (career services and conference attendance) were heavily utilized. We describe several ways that we plan to enhance the successful program elements in the future.

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