Results of a Scholarship Program on Engineering/Computer Science Undergraduate Students Success

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Abstract

A program funded by the National Science Foundation to support student scholarships for undergraduate engineering/computer science students was conducted at the University of New Mexico. The scholarship program involved elements such as faculty mentoring, career development activities and financial support for each student scholar. In this paper, the program details are furnished and data on the positive impacts of such activities on student academic success is presented.

Introduction

The S-STEM (Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM) project (NSF Award ID 1458854) at the University of New Mexico (UNM) officially started awarding scholarships in the fall 2015. Funded through a grant from the National Science Foundation, the S-STEM project at UNM focuses on retaining and graduating academically talented undergraduate students (of low-income background), pursuing degrees in Computer Science or Engineering at this institution. As established in the S-STEM program goals, students are selected on the basis of financial need, academic merit, and potential for professional success.

The S-STEM program funds scholarships of up to $5,500 per student per academic year, distributed equally over two semesters. Recent transfer students receive $4,000 per academic year. This scholarship is renewable as long as the students continue to meet all eligibility requirements. The program revolves around four Learning Communities (LCs)/Cohorts. The four LCs are: Bio-Engineering, Green Technology/Renewable Energy, High-Tech Materials, and Aerospace Engineering. The LC in each of these areas is composed of participating students and faculty mentors with expertise in each of the above-mentioned fields.

This project has benefitted several engineering and computer science students at UNM and allowed them to reduce the need to work to help pay for college. Research studies show that financial aid impacts college student engagement “students from low income families can be academically underprepared for college level work and may not receive adequate information about college that have the right fit or necessary supports.

Students receiving aid may be able to work less and instead spend time engaging with other people and experience outside the classroom, potentially leading to higher course grades and higher rates of persistence and degree completion" [1]. In addition to looking at the impact of financial awards in low-income, academically talented, students of color, research shows that "academic and social behaviors such as course performance, participation in extracurricular activities, and community service all function as potential mechanisms for increasing college graduation rates". Although GPA is also useful to evaluate success, it is better to "understand the mechanisms by which aid may influence a student's academic experiences" [1]. Student success beyond academics suggests that a series of student success workshops and professional development experiences may offer additional motivation to engineering students to remain persistent in their field of study "aid may go beyond academics to non-academic experiences which may also be an important component of collegiate success". [2,3,4,5].

Demographics

Since the start of the program in August 2015, 81 students have received scholarships over 8 semesters. Given the program's stated goals to retain and graduate low-income, academically talented students, it is useful to look at both the general and academic demographics of program participants through the spring semester of 2019.

Table 1. Demographics of S-STEM participants

	Total N=81
Sex	
Female	36%
Male	64%
Race	
American Indian/Alaska Native	4%
Asian	10%
Black/African American	3%
White	54%
Unreported	30%
Ethnicity	
Hispanic	36%
Non-Hispanic	61%
Unreported	4%

Table 1, cont. Demographics of S-STEM participants

Age	Intake	Final Semester
18-24	47%	28%
25-34	44%	54%
35-44	6%	14%
45-54	1%	3%
55-64	1%	1%
Median	25	28
Mean (sd)	26.52 (6.43)	29.11 (6.88)

The scholarship has mainly gone to younger students, with the plurality of students between the ages of 18 and 24 upon entry into the program, with a median age of 25. However, many non-traditional students have also participated, especially those from the ages of 25 to 34. This age group has the majority representation upon exit from the program, with participants roughly 3 years older after completion.

The scholarship has also benefitted males at a much higher rate than females (64% vs 36%). The majority of program participants were white, while the next highest proportion were unreported. However, all of these unreported responses came from students who self-identified as Hispanic, making this the next largest ethnic or racial group. The remaining students who self-identified as Hispanic had a racial identity of either white or American Indian/Alaska Native.

Table 2. Academic demographics of S-STEM participants

	Total N=81
GPA at intake	
Median	3.77
Mean (sd)	3.72 (.262)
Class level at intake	
Freshman	1.2%
Sophomore	16.0%
Junior	29.6%
Senior	53.1%

Table 2, cont. Academic demographics of S-STEM participants

Semesters in Program	
1	8.6%
2	58.0%
3	9.9%
4	17.3%
5	1.2%
6	4.9%
Median	2.00
Mean (sd)	2.59 (1.20)
Intended major at intake	
Computer Science	15%
Chemical Engineering	25%
Civil Engineering	7%
Computer Engineering	9%
Electrical Engineering	12%
Mechanical Engineering	28%
Nuclear Engineering	4%

Participants in the program were academically successful, with a mean cumulative GPA of 3.72 upon intake, which is higher than the average GPA of engineering students at UNM. The S-STEM program also served students at different levels. The majority of students began participation in the program during their senior year, with two semesters the median and most common length of participation. Students with a junior-level standing had the next highest participation, while four semesters was the second most common length of participation. Over half of the students intended to major in either chemical engineering (25%) or mechanical engineering (28%) at intake. The remainder declared some other engineering major.

Services Received through Program

Through the infrastructure offered by the UNM Engineering Student Success (ESS) Center, the S-STEM project has enhanced and develop variety of activities and resources for participants. Many of these activities developed through S-STEM have been institutionalized by ESS and are now benefitting other engineering and computer science students. These activities range from professional development to academic enrichment to career

opportunities, all aiming to improve post-graduation placement of students into graduate programs and STEM-related jobs.

Table 3. Student participation with S-STEM activities

Activity/service type	**% who participated**	**Average number of activities per person (sd)**	**Maximum number of times participated in this activity**
Field trips	62%	1.3 (1.2)	4
Internships	40%	0.7 (1.1)	4
Meetings and conferences	98%	2.3 (1.2)	6
Mentoring	100%	2.6 (1.2)	6
Recruitment	82%	1.9 (1.3)	5
Research opportunities	98%	2.3 (1.2)	6
Seminars	100%	2.6 (1.2)	6
Outreach	31%	0.3 (0.5)	1
Graduate seminar	62%	1.3 (1.2)	4
Other	89%	n/a	n/a

All scholars within the program participated in mentoring and seminars, with many students participating more than once throughout their time in S-STEM. The other most common activities were meetings/conferences and research opportunities, as each of these had nearly universal participation and many students participating twice or more. The least participated-in activity, outreach, was not included on the original survey but was mentioned by a third of students under "Other." While relatively few students participated in internship activities, this is likely due to the competitive nature of such an activity and the pre-existing employment of many students in their field of study rather than a lack of student interest. In addition to listing outreach, many students also listed graduate seminars under "Other," enough to warrant its own category as well. On the whole, student engagement with S-STEM activities was very high and consistent throughout scholars' time in the program.

Table 4. Amount of financial aid received by number of semesters in the program

		Amount of aid			
Number of program semesters		Mean (sd)	Median	Maximum	**N**
1	$2,411 ($632)	$2,750	$1,125	$2,750	7
2	$5,106 ($651)	$5,500	$2,000	$5,500	47
3	$7,562 ($989)	$8,000	$6,000	$8,250	8
4	$10,425 ($1,094)	$10,500	$6,750	$11,000	14

Table 4, cont. Amount of financial aid received by number of semesters in the program

5	$13,750 ($0)	$13,750	$13,750	$13,750	1
6	$15,484 ($1,032)	$16,000	$13,937	$16,000	4
Total	$6,654 ($3,267)	$5,500	$1,125	$16,000	81

A key aspect of this program is to provide financial support to qualified candidates eligible for financial aid as established through a FAFSA application. The minimum scholarship amount per person was $1,125 with a maximum of $16,000. S-STEM awarded scholarship funds to students for multiple semesters, accounting for this difference. Each semester, the average amount of funding awarded was over $2,000 per student. S-STEM awarded a total of $539,012 to students in need.

This relieved students from the stress of finding funding to complete their education, as confirmed by some students:

> *"This program allowed me to focus on school and less on the financial burdens associated with it."*

> *"The NSF scholarship helped me in many ways. It removed my financial anxiety, allowing me to focus on my studies and finishing the last semester of my degree strongly. It also kept me from needing to pick up a second part time job, giving me more time to focus on learning. This scholarship made my final semester more enjoyable and educational in a number of ways."*

Outcomes

Since the S-STEM program has stated goals of higher retention and graduation and improved employment opportunities and graduate placement, we looked at student status after participation, focusing on whether they had graduated, held a job in a STEM field, or were pursuing a higher degree in STEM.

Table 5. Student status after S-STEM participation

	Total N=81
Status	
Active	19%
Graduated	73%
Left Program	9%
Among those who graduated:	
Have STEM job	19%
Pursuing higher education	46%

Table 5, cont. Student status after S-STEM participation

Have job and intend to pursue higher education	30%
Neither reported	5%
Total	100%

S-STEM has been very successful in graduating and retaining students – their graduation rate is 73% (including students still active in the program). Additionally, nearly all of those who graduated reported that they either obtained a job in a STEM field (19%), intend to pursue some form of further education in STEM after graduating (46%), or both (30%). Just 5% did not report either. To assess the success of S-STEM in improving academic outcomes and performance, we analyzed pre- and post-program GPA by a variety of factors, including intended major, whether the student successfully graduated, and their ability to find a job or further education in their STEM field.

Table 6. Pre- and post-program GPA by major, graduation status, job status, and education status

	Pre-program GPA		**Post-program GPA**		**Total N**
Intended major	Mean (sd)	Median	Mean (sd)	Median	
Computer science	3.82 (.14)	3.79	3.80 (.13)*	3.75	12
Chemical engineering	3.59 (.34)	3.63	3.53 (.37)	3.59	20
Civil engineering	3.66 (.20)	3.70	3.62 (.21)	3.69	6
Computer engineering	3.89 (.13)	3.97	3.91 (.10)	3.96	7
Electrical engineering	3.82 (.18)	3.85	3.69 (.28)	3.71	10
Mechanical engineering	3.70 (.27)	3.75	3.68 (.29)	3.75	23
Nuclear engineering	3.74 (.17)	3.83	3.71 (.13)	3.74	3
Graduated					
Yes	3.74 (.23)	3.77	3.73 (.24)**	3.77	59
No	3.66 (.34)	3.76	3.54 (.36)	3.64	22
Job/Further Education					
Only education	3.76 (.21)	3.76	3.73 (.23)	3.77	27
Only job	3.64 (.28)	3.65	3.64 (.26)	3.75	11
Both	3.76 (.21)	3.77	3.76 (.24)	3.76	18
Total	3.72 (.26)	3.77	3.68 (.29)	3.75	81

While it is not possible to evaluate the success of S-STEM in improving academic outcomes without broader College of Engineering GPA data, it is immediately clear that S-STEM participants largely held their cumulative GPA consistent from intake to exit, with an average drop of 0.04. No subgrouping dropped to another grade band, and some even saw an increase in their mean (computer engineering) or median (only education, only job). On the whole, however, there is a remarkable consistency in both mean and median, with a general slight increase in standard deviation for all subgroupings.

S-STEM has also collected student evaluations on the program through survey questions, summarized below in Table 6 for years 2015 to 2018. This provides supplemental information on how well S-STEM has achieved its stated goals.

Table 7. Post-participation student survey results

Implementation and Outcome Statements		Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
ADVISEMENT	1. I am satisfied with the overall guidance received from my department's academic advisor.	59.8%	35.2%	2.9%	2.1%	0.0%
	2. As a result of my meeting(s) with my department's academic advisor, I was able to make good choices in my course selection.	64.3%	32.1%	2.6%	1.0%	0.0%
NSF PROGRAM	3. I gained valuable information from the e-mails sent by the NSF Scholarship Program.	58.3%	37.5%	3.1%	1.2%	0.0%
	4. Meetings with the NSF Scholarship Program faculty and/or staff have been informational.	59.1%	35.6%	5.3%	0.0%	0.0%
	5. The information provided at the workshops I attended this semester was very important for my professional and/or personal development.	61.9%	30.7%	6.2%	1.2%	0.0%
	6. Participation in the NSF Scholarship Program helped me to improve my GPA because it allowed me to focus more on my studies.	53.4%	28.8%	16.4%	1.4%	0.0%
	7. The scholarship provided by the NSF Scholarship Program allowed me to work fewer hours in a non-academic-related position.	71.9%	12.5%	12.3%	3.3%	0.0%

	8. I received referrals to other services on campus when appropriate (financial aid, career services, etc.)	59.4%	36.0%	4.5%	0.0%	0.0%
	9. The help received from NSF Scholarship Program has been fundamental for my success as student this semester.	75.8%	20.9%	3.0%	0.4%	0.0%
	10. Overall the NSF Scholarship Program has met my expectations.	79.9%	18.6%	1.5%	0.0%	0.0%

For all questions, student response never dropped below 50% strongly agree, with no student ever strongly disagreeing with any of the survey statements. Additionally, scholars never disagreed more than 4% of the time, although undecided did exceed 10% on a few statements. More than 90% of students in all years agreed that S-STEM benefitted their personal and professional development, while around 82% of all students felt that participation improved their GPA. While there were no survey questions on whether S-STEM had improved their ability to graduate, almost 97% of students felt it had been fundamental to their success.

Summary and Conclusions

Both the qualitative and the quantitative data suggest that S-STEM is a successful program. Graduation rates and reports of post-program career and higher education placement are extremely positive. The students participating in this program are high achieving in terms of GPA, and indeed, have a higher GPA than average for the School of Engineering. They also demonstrated financial need and were eligible for aid. This program ensured that these students were able to achieve their goals of obtaining a degree in engineering.

Authors

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