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Impact of Scholarships and Academic/Career Development Activities on the Success of Undergraduate Students

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Abstract

A program funded by the United States National Science Foundation (NSF) 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. The myriad of activities covered by the program was positively received by the student scholars.

Introduction

The S-STEM (Scholarships in Science, Technology, Engineering, and Mathematics) 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 (NSF), 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 student engagement, as "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]. Scholarships for community college students working towards associate degrees in STEM have also been shown to improve outcomes [2]. In the study by [3], it was found that offering $1,000 of grant aid increases educational attainment by about 0.16 years and the probability of attending college by four percentage points. The study by [4] found that four-year renewable scholarships encourage student persistence in college; possibly because of relief from financial concerns, mutual institution-student commitment, and a sense of responsibility that accompanies honor and recognition, or a combination of these factors.

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". [5-8]. Indeed, undergraduate research experiences have been shown to increase the likelihood of participants attaining a post-baccalaureate degree or working in STEM [9]. Additionally, meta-analyses have confirmed that faculty mentoring does improve retention and graduation outcomes for undergraduates, although it is unclear whether this is true for students enrolled in STEM fields specifically [10]. Lastly, the recent work by [11], showed that faculty mentoring, internships and professional conference participations improved student outcomes in terms of retention and graduation.

The main goal of this study is to determine if student success metrics, such as retention and graduation rates as well as GPA (Grade Point Average), are positively impacted by the suite of academic and career development activities offered to the students, along with their scholarship offering, as availed by the NSF S-STEM program.

METHODS

The methods employed in this work involve: data collections, pictography, surveys of students (every semester), academic and career development activities, basic statistics, and personal interviews (at graduation). Personal data is kept confidential and students consent ahead of time to sharing info about them, including photos.

RESULTS

Demographics

Since the start of the program in August 2015 (through Spring 2019), 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 2019 Spring semester.

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)

As Table 1 shows, 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 an unreported race. However, all of these unreported responses came from students who self-identified as Hispanic, making this the second largest 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%

Table 2 represents the academic profile of participants in the program, showing general academic success. At intake, students had a mean cumulative GPA of 3.72, which is higher than the average GPA of engineering students at UNM. The S-STEM program also served students of different years/standing in their degrees. The majority of students began participation in the program during their senior year, with the median being two semesters (the 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 or computer science.

Services Received through the Program

Through the infrastructure offered by the UNM Engineering Student Success (ESS) Center, the S-STEM project has enhanced and develop a 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 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 Activities	100%	2.6 (1.2)	6
Recruitment Events	82%	1.9 (1.3)	5
Research Opportunities	98%	2.3 (1.2)	6
Seminars	100%	2.6 (1.2)	6
Outreach Events	31%	0.3 (0.5)	1
Graduate Seminars	62%	1.3 (1.2)	4
Other Activities	89%	n/a	n/a

As Table 3 shows, all scholars within the program participated in mentoring and seminars, with many students participating in more than one of these activities throughout their time in the S-STEM program. 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. Outreach has the lowest participation rate due to its not being included in the original survey, as it was only mentioned by a third of students". While relatively few students

participated in internship activities, this is likely due to the competitive nature to enter such an activity, and the pre-existing employment of many students in their field of study, rather than a lack of student interest in the activity. In addition to listing outreach, many students also listed graduate seminars in their survey of activities," 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.

Here are examples of activities that were made available for the S-STEM Scholars and many scholars did participate in:

SPRING 2016

1. USA Jobs Tutorial provided by the Nuclear Weapons division of the Air Force Research Laboratories: January 29, 2016.

2. Packaging Yourself Professional Workshop presented by Dr. Kenny Armijo, Research Scientist at Sandia National Laboratories: February 4, 2016.

3. Intel Corporation Networking Event: February 8, 2016.

4. Career EXPO 2016: February 9, 2016.

5. Introduction to NAVAIR: February 9, 2016.

6. Undergraduate Research Opportunities presented by the McNair Undergraduate Research Program at the University of New Mexico: February 19, 2016.

7. Seminar on "Publishing, Patenting, and Start-ups" presented by the New Mexico Society of Professional Engineers: March 23, 2016.

8. Student Job and Internship Fair: April 7, 2016.

9. Presentation and Tour of the Center for High Technology Materials at the University of New Mexico South Campus: April 29, 2016.

10. Information Sessions presented by AEROTEK and Air Force Research Labs Representatives: May 3, 2016

11. Scholars served as panelists at the School of Engineering Scholarship Information Session: May 6, 2016.

FALL 2016

1. Developing a Professional Resume and Cover Letter Workshops in preparation for the Career Fair (in collaboration with the Office of Career Services): Sessions from September 9-13, 2016.

2. Resume Critique Session by Engineering Professionals provided by the Society of Hispanic Professional Engineers in partnership with our NSF Scholarship Program and Engineering Student Services: September 12, 2016.

3. Industry Networking Social sponsored by the NSF Scholarship Program and Engineering Student Services: September 13, 2016.

4. Students attended the Engineering and Science Career Fair held on September 14, 2016 and various Company information sessions.

5. NSF Graduate Research Fellowship Program (GRFP) Program Manager, How to Apply Seminar: September 19, 2016.

6. Google Information Session: September 29, 2016.

7. Presentation by Trane Corporation on 'Geothermal and Sustainable Building Systems': October 19, 2016.

8. Presentation by the Aerospace Corporation on company research and development and internship and job opportunities: October 24, 2016.

9. Intel Corporation Visit: November 17, 2016.

10. Los Alamos National Laboratories presentation: November 30, 2016.

11. Research Opportunities for Undergraduates and Graduate Opportunities with the Material Research Science and Engineering Center: December 5, 2016.

Although only activities from the 2016 year were presented above, activities in other years were similar in number and varied in their breadth and diversity. Below (Figures 1-5), we present pictures of some of the above-listed activities in Table 3.

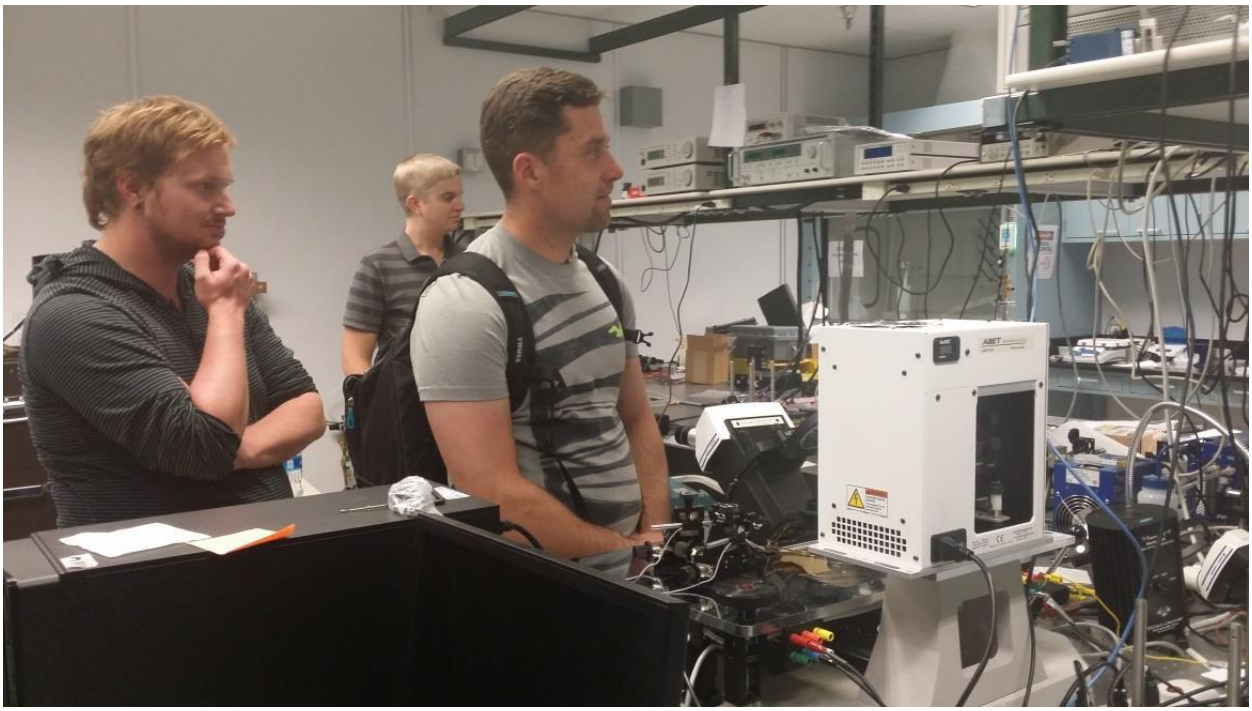

Figure 1. Scholars visiting the Center for High Technology Materials at UNM: April 29, 2016

Figure 2. INDUSTRY NETWORKING SOCIAL: September 13, 2016

Figure 3. Seminar on "Publishing, Patenting, and Start-ups" presented by the New Mexico Society of Professional Engineers: March 23, 2016.

Figure 4. NSF Scholars meeting former NASA Astronaut Jose Hernandez (Center): October 3, 2018

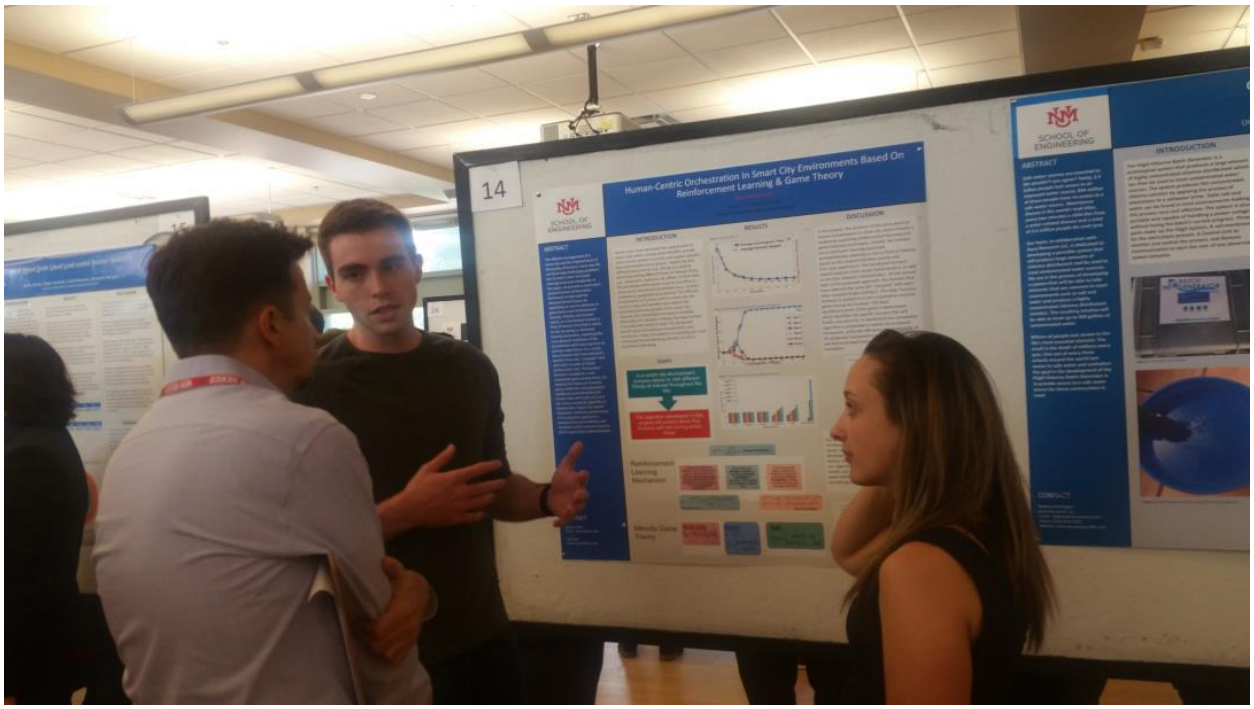

Figure 5: NSF Scholars at the UNM SOE Engineering EXPO: May 3, 2019

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

Number of Program Semesters	Amount of Aid				N
	Mean (sd)	Median	Minimum	Maximum	
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 (Free Application for Federal Student Aid). Table 4 provides the mean, median, minimum, and maximum scholarship amounts for each semester of participation. The minimum scholarship amount per person over the whole time of participation was $1,125, while the maximum was $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).

Table 5. Student status after S-STEM participation

	Total
	N=81
Status	
Still Active in Program	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 – the retention rate within the program is 92%, while the graduation rate is 73% (not counting students still active in the program and likely to graduate). The success of the program is also reflected when comparing the retention of students in the S-STEM program to the average 8-semester retention for students within the School of Engineering (SOE), who started in the 2015 year, which currently sits at 59%. In terms of graduation rates (based on the 2015 year when scholarships were first awarded), the School of Engineering showed a 50.4% graduation rate, whereas the program produced a 73%+ graduation rate. It is clear that the S-STEM program is producing much higher retention and graduation rates than the SOE overall rates.

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 any of these three.

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).

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 7 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	75.8%	20.9%	3.0%	0.4%	0.0%

	Scholarship Program has been fundamental for my success as student this semester.					
	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.

Student Testimonials

The program receives, every semester, many positive testimonials from the student scholars expressing how valuable this NSF scholarship program has been to their academic success and overall lives. Below are several quotes selected to illustrate just that.

A 2019 scholar: “The NSF S-STEM Scholarship really empowered me to pursue excellence in research and classes. By enabling me to focus less on finances, I was able to devote all my attention to coursework and research.” “The NSF S-STEM Scholarship really empowered me to pursue excellence in research and classes. By enabling me to focus less on finances, I was able to devote all my attention to coursework and research.”

A 2019 scholar: “The NSF Scholarship program enabled me to attend school full time, provided me with opportunities to volunteer at outreach events, and get me to career development and networking events.”

A 2018 scholar: “The NSF program not only made it possible to return to school, but possible for me to do an honors project, attend extra lectures, and network with professors, professionals and my fellow students.”

A 2018 scholar: “It was a rewarding and challenging experience. I am happy to finally receive the scholarship the last semester of my bachelor’s degree after re-applying 5 times. I enjoyed the mentorship and networking opportunities I received from the program. The organizers and mentors were passionate about preparing their students’ for academic careers and their future. The final presentations/award ceremony was a highlight of the program for me. Hopefully, NSF continue to see the value and impact this program have on UNM students and continue to provide funding for our future students.”

A 2017 scholar: “I want to say the workshops on career development were influential in improving my applications to graduate school and obtaining the position I have now. The environment was super encouraging and constructive to allowing me to see different probabilities and I am truly grateful.”

A 2017 scholar: “Without the NSF Scholarship, I am 100% confident that I would not have graduated with the high level of success that I did. Not having to work as many hours afforded me the time to graduate with university & departmental honors and the ability to obtain a fellowship to the top nuclear engineering school in the nation. Thank you, the NSF committee, and to Elsa.”

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 and further their career. In short, the authors believe that the program goals were achieved and would recommend to others to consider its elements for student success initiatives at their institution.

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