

## Impact of Awarding Scholarships to Current Students

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# **The Results and Impact of Awarding S-STEM Scholarships to Current Students**

## **Abstract**

Lamar University in Beaumont, Texas was awarded an NSF S-STEM grant “Industrial and Mechanical Engineering Scholars with Scholarships, Career Mentoring, Outreach and Advisement, Professional Societies and Engineering Learning Community (SCOPE) S-STEM Program” in 2015. Unlike most scholarship programs that target incoming students, this scholarship targets enrolled students who have demonstrated successful progress towards a Mechanical Engineering or Industrial Engineering degree by having minimum grades of B in Calculus I, Calculus II and Physics I and an overall GPA of at least 3.0. The SCOPE program requires scholarship recipients to be an active member of the academic community, participate in professional societies, and participate in career mentoring. Almost all SCOPE scholars are on track to complete their degree with strong academic performance. This paper presents the program achievement so far and documents the results and impact of awarding scholarships later in the academic program based on academic performance, retention, and survey data.

## **1. Introduction to the S-STEM Scholarship**

In 2015, Lamar University in Beaumont, Texas was awarded an NSF S-STEM grant titled “Industrial and Mechanical Engineering Scholars with Scholarships, Career Mentoring, Outreach and Advisement, Professional Societies and Engineering Learning Community (SCOPE) S-STEM Program”. SCOPE Scholars participate in career mentoring, outreach and advisement, professional societies, and learning community activities throughout the program. These activities have been successful in similar programs to support and retain students [1-5]. This paper presents the results of the SCOPE scholarship program in terms of student retention and active participation in campus activities.

The project addresses the difficulties of completing an engineering degree and joining the labor market for students from low income backgrounds. To reduce financial burdens, the program provides scholarships that limit both debt load and the need to work while in school. The SCOPE program combined with other scholarships and income from employment eliminates or dramatically reduces the need for loans for the participants. The program also provides career advice and encouragement for professional and university involvement. Our goal for scholarship recipients is that they graduate and find employment within their field of study or attend graduate school.

The scholar selection criteria are:

1. U.S. Citizen, Permanent Resident, U.S. National or aliens admitted as refugees;
2. Enrolled full time for each long semester in which a scholarship is received;
3. Incoming sophomore, junior or senior; sophomore has priority;

4. Have completed Calculus I, Calculus II and Calculus-based Physics I with minimum grades of B;
5. Have a minimum Lamar GPA of 3.0 (cumulative and within the major), or otherwise demonstrate successful progress towards and commitment to the completion of IE/ME degree;
6. Have declared Industrial Engineering or Mechanical Engineering as their major;
7. Demonstrate financial need as defined by the US Department of Education rules for need-based federal financial aid - Free Application for Federal Student Aid (FAFSA).

Based on this requirement, the scholars are selected from current students, not freshmen. SCOPE Scholars are expected to receive enhanced mentoring and participate extracurricular activities. They must participate in activities including:

1. Career mentoring – Scholars must meet with a professor to discuss resumes, internships and career planning.
2. Outreach and advisement – Scholars must meet with a professor to discuss academic performance and issues.
3. Professional certification and professional societies – Scholars must be members of either Institute of Industrial and Systems Engineer (IISE) or American Society of Mechanical Engineer (ASME).
4. Engineering learning community – On campus scholars must be members of learning communities in the dorms. Most scholars live off campus.
5. Activities to support SCOPE recruiting and assessment – Scholars respond to online surveys twice per semester, organized by the project assessment specialist. Some scholars are randomly selected for face-to-face interview by the assessment specialist.

A point system is used to track optional activities to support the five scope areas. The program employs the point-based system to quantify student activities. The points are given for the above activities. After adjustment, we now required 15 points per semester for all student scholars. The guidance note of the activity requirement is posted in the SCOPE project website [6].

The rest of the paper is organized with follows. Section 2 conducts a brief literature review for results and impact of scholarship on the student performance reported from similar studies or scholarship programs. Section 3 presents the scholar academic performance and retention rate results. Section 4 discusses the results from the scholar survey data. Section 5 lists the interesting quotes from scholars. Both Sections 4 and 5 results are provided by the assessment specialist to document the objective evaluation of the scholarship impact. Section 6 presents a few lessons learned from the scholarship program. Section 7 concludes the paper.

## **2. Literature Review**

This paper examines the impact of the scholarship awarded after Calculus I, Calculus II and Calculus-based Physics I on student performance and student retention rates. There are multiple studies on the correlation of student performance with their academic preparation in lower division courses or earlier. A study at Iowa State demonstrated a 67% completion rate for students making above 3.5 in Calculus I [7]. What is the most interesting in the Iowa State study is: there are limited differences exists between taking Calculus I at the university and a

community college in terms of predicting student success in engineering programs. At Texas A&M, Froyd et al. demonstrated that students with an A in Calculus I had an 80% chance of completing the four-course engineering math sequence, students with a B had a 60-70% chance and students with a C had a 40-50% chance [8]. Hieb et al. found that 42% of variation in performance in Calculus 1 could be explained by ACT and other predictors [9]. The difficulty in predicting student performance in Calculus I combined with the strong association between success in Calculus I suggests that having Calculus I scores allows a decision maker to select scholarship students who are likely to graduate.

The retention rates for incoming freshman scholarship-based programs with activities for scholars range from Wesley was 55% [10]; a Louisiana State University study focused on mentoring achieved about 70% graduation rate [10]; 62-72% retention rate at Bowling Green [12]; and 45% graduation rate at Alabama [13]. At Boise State University, Olson and others report a near 100% retention rate for transfer students in a similar STEM scholarship program to SCOPE [14]. Another study at Arizona State University (ASU) that provide scholarships and support to transfer students achieved a 92% graduation rate [15]. The ASU study also demonstrated that transfer students in the scholarship program had higher GPAs and were more likely to go to graduate school [16].

### **3. The Result on Scholar's Academic Performance and Retention Rate**

All 35 scope scholars who joined the program are on track to graduate. By the end of the third year, 13 are currently active, 16 graduated, 5 left the SCOPE program due to lack of need, and one left SCOPE prior to graduation due to taking a reduced course load. The five that left the program due to lack of need are still progressing towards graduation. One primary reason for lack of need is the income from co-op and other income sources makes the students ineligible for the program. The program is on track to have an extremely high graduation rate for scholars.

Several factors could contribute to the success of the program including the selection criteria and consistent assistance from supporting activities. Our student scholars are selected with a high academic background requirement. This group of students also received guidance and mentoring with career and academic progress advising each semester. The combination of advising, profession activities, and financial support might contribute to the graduation rate and strong academic performance. Our experience with SCOPE scholars echoes with the studies found in the literature that the lower division course performance is critical to the success of students in their study and graduation rate [7, 8, 9]. While the scholarship was awarded to current students doing well, the high completion rate with all students graduate or still enrolled in the program of our scholars is still notable. Our results were in line with the literature's findings for transfer student scholarships [14, 15, 16]. Our study combined with the literature indicate that scholarships can be awarded to students who will graduate if the decision maker has access to information about lower division course performance.

The SCOPE scholarship program has run for 3.5 years. Among all the scholars, only one student's GPA fell under the minimum requirement of 3.0 GPA and leads to one semester's probation. The scholar was able to raise their GPA and continued to be eligible for the program.

#### 4. Survey Results

In the most recent survey, a total of 27 SCOPE scholars in the College of Engineering (25.93% Hispanic, 48.15% White/Caucasian, 14.81% African American, and 7.41% Asian/Pacific Islander) were comprised of eighteen seniors, eight juniors and three sophomores, and completed the survey. By comparison, the demographics of the industrial engineering and mechanical engineering departments at Lamar University are (50% White, 21% Hispanic, 15% African American, and 9% Asian). A majority of the scholars were male (71.43%), and their mean age was 24.25 (SD = 5.12; range 20–42). For Industrial and Mechanical Engineering students at Lamar University, 82% are male and 18% are female. Three students indicated that they were the first generation to attend college. Five students indicated that English was not their first language, and two students noted that they felt language was a barrier in their courses.

Seventeen students (17/27 = 62%) stated that they were employed. Seven (7/27 = 26%) of them said their employment was not directly related to their major with ten (10/27 = 32%) being employed related to major during the semester. The rate of employment during the semester suggest that the students do have financial concerns. While the scope scholarship and other financial aid should have covered the financial needs of the students, a significant percentage remained employed during the long semester. The impact that employment has on retention of engineering students is unsettled in the literature [17-20]. At Lamar University, many students work in non-engineering roles in the local heavy industry such as equipment mechanics, so the line between major related employment and employment not directly related to major is often blurred. All SCOPE scholars have some paid worker experience in co-op, internship, paid research experiences, or employment outside of major.

When asked for their primary reason to apply for the scholarship, the majority (66.67%) of them identified financial support for their study. Better job prospects, enhancing academic performance, and future career support were identified as the next most important factors. As means of communication, students reported that in addition to interacting with one another in person, some of them took courses together, and they also used social media and mobile apps, such as MobileMe. As shown in Table 1 below, SCOPE scholars have reported that their activity participation and time spent on campus have all increased as a result of their SCOPE scholarship experience. Over ninety percent of the participants indicated that their quality of campus life has increased due to their scholarship.

**Table 1. SCOPE Activity Participation Change.**

SCOPE Experience	Decreased	Remained the Same	Increased
The time spent on campus	0%	18.52%	81.48%
The number of campus academic events	0%	14.81%	85.19%
The number of campus social events	0%	25.93%	74.07%
The number of people interacted academically	0%	25.93%	74.07%
The overall quality of my campus life	0%	7.41%	92.59%

SCOPE scholars are very creative in outreach and advisement. Besides the activities specifically listed in the activity guidance notes, scholars have proposed many new activities. For example, after Tropical Storm Harvey flooded our area, students participated in volunteer activities to help restore flooded homes. Therefore, the activity list is updated each year to add more options. The start of SCOPE program coincides with the rising of undergraduate research within the university. So far, four scholars have received academic year undergraduate research grants and one scholar has received a more competitive summer research fellowship. They have presented their results in the Undergraduate Research Expo and the Texas STEM Conference. In addition, they have applied for various other opportunities such as McNair Research Scholarship and DoD STEM scholarship. The following are the sample projects pursued by SCOPE scholars supported by undergraduate research grants.

- Supercapacitors from Recycled Industrial Mill Scale Waste
- Modified Power Plant Solid Waste (Fly Ash) for Absorption of CO<sub>2</sub>
- Nanoparticles as Lubricant Additives for Friction Reduction in Internal Combustion Engines
- Fabrication of 3D-Printed Meta-materials for Energy Absorption Applications

ASME (American Society of Mechanical Engineers) and IISE (Institute of Industrial and Systems Engineers) student sections organized many field trips and seminars. In addition, the local professional section of ASME and ISA (International Society of Automation) are active with monthly field trips or professional seminars due to the intensive presence of petrochemical and service companies including Metalforms and Ohmstead, etc. Many SCOPE scholars are interested in participating these professional societies activities to better understand real world engineering as well as look for internship or co-op opportunities. One SCOPE scholar has assumed the leadership in the ASME student section as the President. Another SCOPE scholar initiated Lamar University student section of American Society of Heating, Refrigeration and Air-conditioning Engineers (ASHRAE) and became the its inaugural President. Besides ASME, IISE, ASHARE, and ISA, SCOPE scholars are involved in several professional societies or

organizations including Student Engineering Council (SEC), Society of Women Engineers (SWE), National Society of Black Engineers (NSBE), Society of Hispanic Professional Engineers (SHPE), and Society of Asian Scientists & Engineers (SASE).

## 5. Scholar Interview Results

Regarding the impact of the SCOPE scholarship program, most students indicated increased interactions with peers and more involvement in campus activities since they have become scholars of the program. The data showed that the SCOPE scholarship activities prompted them to interact more amongst themselves and with new people through group activities or organizations. Below are some example quotes from students who described their campus life change by comparing before and after the SCOPE scholarship experience:

- Before scope I just kind of went to class and went home. Now, I select people I study with and do homework with for my classes, and these people are SCOPE scholars. It's great to have a circle of such good students sharing the same goals of success and will power to persevere through anything.
- Before I participated in the activities SCOPE recommended or met the people involved, I was worried to be a part of those social events and I was short on friends on campus. This scholarship has helped me navigate that part of academic life. It has encouraged me through its point system to keep up with beneficial groups such as ISA and ASME. I was even able to become an officer and plan events for ASME. The largest part of this has been the encouraging friends I have found who have the same sense of achievement and goals.
- Before SCOPE I would mostly go to class then go home. After SCOPE I became part of many organizations and campus activities. It truly made college a part of my life I will cherish forever.
- I have definitely expanded my roots into different places. SCOPE made me move out to organizations that have also moved me.
- ... before I became a SCOPE scholar, I hardly attended events. As a requirement, I became a member of ASME (American Society of Mechanical Engineers) and started my involvement in other organizations like ISA (International Society of Automation) or once with SWE (Society of Women Engineers) and ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers). I have been more open to meeting new people. Now, I know many faculty members to contact if I need any help with schooling, my career, or friendly conversation all of which I believe will help me in my projects and graduation.
- SCOPE literally changed the whole dynamic of my college experience. Previously, I would only attend Lion's Club events and activities. But because SCOPE required activity through ASME, I was pushed to become more involved and active. I never took advantage of the opportunities ASME and SWE provided, but through SCOPE I took the initiative and got the drive to be more involved and attend events. I was able to make friends and get to know on a more personal

level. And we also worked together on two different projects, and helped each other throughout the semester. Also, my SCOPE scholar mentor was so incredibly helpful anytime I had a question. I enjoyed meeting older and experienced engineers and hearing their experiences through different events. I firmly believe that being a SCOPE scholar has transformed my college experience.

It is noteworthy that many students reported positive changes that are significant enough to see differences in terms of their involvement of campus events both socially and academically. According to students, many of the frequent participation got prompted by the organized events or by the recommendation from their peers, senior mentors, and faculty mentors. All the scholarship activities and interactions with peers and mentors seemed to positively influence present as well as future prospects as can be seen from a quote:

Before I never spent much time on campus or knew what I wanted to do with my degree. Now, I feel more comfortable on campus and have a plan after I graduate.

## **6. The Lessons Learned from the Scholarship Program**

The following operational lessons were learned during the project:

1. It is important to disseminate the activity information timely, and through multiple communication channels. Because all students are very busy with their coursework and other duties, we found that they do not check available activity information frequently. More importantly, we found that students are more likely to attend activities when they are informed and reminded of upcoming events. Students, during the interview, said that they really appreciated reminders from peers and mentors.
2. One of the SCOPE scholarship program objectives is to encourage students to participate in undergraduate research which can directly impact on both the undergraduate education quality and future graduate school enrollment. Our scholars are typically concerned whether their undergraduate research would take too much of their time and they would not have time left for their own course study. In order to help them better understand the undergraduate research process, during the orientation at the beginning of each year, we invited more experienced scholars who participated in undergraduate research to share their experience and how that could positively impact their study and future goals.
3. Peer mentoring is useful. Students learn from one another and from their seniors. When they are uncertain about something, they turn to their peers and their seniors for better informed decisions. Therefore, a small guidance from peer mentoring may lead to big decisions.
4. Faculty mentors need to be actively involved with student activities. Students are limited by their time and willingness to attend activities. If faculty mentors lead them to attend a few activities and they will soon start to realize the importance of meeting people and involvement in various professional activities for their future career.



5. Resume reviews are an effective tool to start meaningful conversations about careers and graduate school between students and faculty members.

These lessons may help us to enhance our program to improve the impact of scholarship program.

## **7. Conclusion**

The SCOPE project is producing a group of students who are career focused and professionally active with significantly lower debt burden. The success of these students might encourage other students with similar background to study engineering and other STEM fields.

The finding of the range of studies, included the results reported in this paper, can help policy makers develop effective rules for scholarship programs designed to promote STEM. Future studies should try to determine if providing scholarships after the freshman year is a cost-effective method of promoting STEM. By providing scholarships after the freshman year, the graduation rate is high for participants, but many participants might have graduated without the scholarship and associated activities.

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