The S-STEM Scholars Program: A Look Back and Lessons Learned

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Abstract

Financially needy students typically must work to support their academic pursuits, thus reducing the time they have to devote to study or to participate in professional development activities that can contribute to their future success. Begun in 2010 and concluding in 2016, the S-STEM Scholars Program at Western Michigan University (WMU) was funded by a grant from the National Science Foundation with the goal of providing increased opportunities for financially needy but academically talented students in STEM disciplines within the WMU College of Engineering and Applied Sciences. The S-STEM Scholars were tracked throughout their undergraduate degree programs, and data collected to measure student success. Data included retention rate, time to degree, student participation in professional development activities, internship and co-op placements, and rate of success for post-graduation employment or graduate program enrollment. This paper focuses on outcomes measuring the level of the program's success, as well as lessons learned. The S-STEM Scholar program results should be useful to faculty considering similar engineering education undertakings at their site.

Keywords

S-STEM, scholarships, retention, student success

About the College of Engineering and Applied Sciences at Western Michigan University

Western Michigan University (WMU) is a comprehensive state-sponsored regional university located in Kalamazoo, MI. In the Fall Semester 2015, there were 18,567 undergraduate and 4,989 graduate students enrolled. The College of Engineering and Applied Sciences (CEAS, to be referred to as "College") offers 14 undergraduate degree programs with an enrollment of 2,431 in Fall 2015; and offers 9 masters and 5 doctoral programs with 643 graduate students.[1]

A typical College graduate profile for an undergraduate student at WMU, as gathered from senior exit surveys and from employer surveys, is a student who worked part-time while attending classes and took 10.5 semesters to graduate. The students enjoy a practical hands-on side of engineering that they learn at through projects, laboratory, design-build competitions, and involvement in applied research. Employers rated College graduates as highly desirable when compared to other engineering schools because they have a shorter on-the-job learning curve as a result of the practical experience they gained. Faculty members engaged in industry-supported research usually involve undergraduates. Thus, the graduate profile reflects the College vision of "*A scholarly community dedicated to excellence through student-centered education and research emphasizing professional practice in engineering and applied science"* and the College

mission of preparing "*job-ready graduates*." Analyses of academic records show that while those who reported they work part-time took about the same number of credit hours per semester during their first year at Western Michigan University and achieved similar grade point average (GPA), students who reported they work part-time have a lower 2nd year retention rate in engineering and applied sciences (69.7%) than those who reported they did not work (75.8%), although the difference is not statistically significant (α=0.44).[2]

Project Objectives and Background on S-STEM Scholars Program

Begun in 2010, the S-STEM Scholar Program at WMU increased opportunities for financially needy but academically talented students. These students:

- Came into the S-STEM Scholar Program as first-time, first year students
- Demonstrated financial need through FAFSA applications
- Entered a STEM major in the College
- Had a math ACT of 24 or above

S-STEM Scholar Program objectives were 1) to provide scholarships so recipients could devote full-time attention to academic studies and participate in student development activities without outside employment distraction, and 2) to provide professional development activities to connect scholarship recipients to other students and faculty, and to the engineering and applied sciences professions. Students had a choice of three different programs for professional development: the Undergraduate Research Program, the Student Organizations of Professional Societies Program, and the Co-Op Program. Furthermore, the project researched the impact of financial scholarships on student success, retention, professional development, and time-to-degree completion by addressing the following **Research Questions**:

Compared to other financially needy students and the general population of first-time, first-year College students who do not work…….

1. Do scholarship recipients perform better academically?
2. Do scholarship recipients have higher retention rates?
3. Do scholarship recipients make greater time-to-degree progress to completion?
4. Do scholarship recipients participate in engagement activities and professional development at a higher rate to prepare them for success?
5. Do a greater percent of the scholarship recipients participate in summer internship or co-op programs with industries?

Specifically, the project was structured according to the following objectives:

Objective 1: Provide scholarships so recipients can give full-time attention to academic pursuits and endeavors so that their time and energy is not all focused on jobs.

Objective 2: Provide professional development activities to engage recipients with other students, faculty, and the engineering and applied sciences professions to give them skills that will increase their success.

Objective 3: Provide professional development activities and support to prepare the scholarship recipients for the option of participating in a summer internship or co-op as a pathway to enter into the engineering and applied sciences work force, or as preparation for graduate studies.

Students eligible to receive these scholarships were required to be U.S. citizens or legal residents, academically talented, and have demonstrated financial need.

Professional Development Integrated in the S-STEM Scholars Program (Objectives 2 & 3)

S-STEM Scholars chose one of the following three professional development opportunities when they applied to the program; students could switch each new academic year if they wished:

1. Undergraduate Research: Students learned engineering through experience and developed the habits and skills of a researcher. S-STEM Scholars got help finding an undergraduate research project but were expected to be proactive in seeking such projects.
2. Student Organizations of Professional Societies: Scholars were expected to join and be active participants in at least one of 34 such organizations on campus.
3. Co-op and Internship Opportunities: Chosen mostly by second-year students and later, an excellent option for students to gain on-the-job experience, connect learning in the classroom to professional practice, and develop communication, teamwork, and leadership skills.

A summary of outcomes from the professional development activities for this project are highlighted below.

Professional Development: Undergraduate Research

Over the six-year period for the S-STEM grant, seven of the 33 individual students engaged in undergraduate research. Three students conducted research in four different academic years, and two others conducted research for two academic years. Of the five students who engaged in research for more than a single academic year, four are enrolled in graduate studies as of Fall 2016, or plan to when they complete their B.S. degree program in the 2016-17 academic year. S-STEM Scholar student researchers presented eight conference posters or papers on their work.

Professional Development: Student Organization or Societies

Over the course of the project, each student regularly participated in the Student Organization of their choice and was in regular contact with one of the project co-PIs for discussions about their participation. An electronic report was created and students were responsible to complete it at least twice per academic year. In their reports, the S-STEM Scholars were required to highlight their activities in their chosen societies and their levels of engagement, making them self-aware of the need to be engaged in their professions and reporting to the supervising investigators the value as perceived by the students. During the grant period, at least 29 of the 33 (87.9%) S-STEM Scholars were active in a Student Organization, most for several years.

Professional Development: Co-op and Internship Opportunities

Participation in summer internships increased steadily when compared to the first summer, with 1 of 6 students in summer 2011 finding a placement. Placements in 2012 were 6 of 16 students who actively sought an internship position; in 2013, 8 of 13 students in internships, plus two research placements; in 2014, 11 of 15 students, plus two research placement; and in 2015, 4 of 8 students, plus one research placement. For the summer placements listed above, 15 of the internships were for a unique student; 3 unique students did summer research; and one student had both the summer internships and summer research experiences. A total of 16 unique S-STEM Scholars engaged in an internship experience (one of which also had an academic year co-op experience), out of 33 total students, or 48.5%, which increased to 57.6% when including summer research students. This rate of participation relates to **Research Question 5.**

The students regularly attended the S-STEM Scholar program professional development sessions on looking for internships and co-ops, resume writing activities, and preparing for and using the College's Fall Career Fair. Nearly all the S-STEM Scholars at some point sought advice and assistance to develop their internship and job-seeking skills, while they were also involved in the Research or Student Organization opportunities or undergraduate research. This high rate of participation relates to **Research Question 4.**

Data Analysis

Collected data were analyzed from the first seven semesters of the project. The method employed was the 2-lvl Hierarchical Linear Modeling (HLM), which allowed us to control student background, and investigate further into the effect of working hours on student achievement, as measured by a student's cumulative GPA. We developed the null model, control model, and full model to check how the models improved after adding control variables and predictor variable. We learned that neither student's gender, ethnicity, nor working hours were significantly related to student GPA growth (P-values were not significant). Expansion of the data set to include similar data collected through eleven semesters (through the Fall 2015 semester) did not yield any significant correlations.

There were several limitations of the analysis performed. First, it is possible that the growth of GPA might not be the best measurement of student performance, given that the computation of GPA is not based on the results of standardized tests of the same classes taken by each of the S-STEM Scholars. Second, one way for a student to mitigate the risk of a poor GPA would be through reducing their work hours. Therefore, the possible negative impact of the number of hours worked on a students' GPA is likely to be at least partially offset by a students' own decisions: they might take on less work if they expect that the classes they have enrolled in will be difficult.

With 33 student participants in the S-STEM Scholars program over the time of the project, a large enough data set to explore other correlations was not possible. An answer to the outcomes for Research Questions 2, 3, 4, and 5 can be found from other compiled data and comparison to the larger group of enrolled students in the College. It is not possible to draw a meaningful conclusion to **Research Question 1**, other than retention data and time to degree, as we did not

attempt a GPA comparison in comparison to student hours worked across the entire College, as data about hours worked by students outside the S-STEM Scholar program is not collected by the College.

S-STEM Scholar Program Retention

From Fall 2010 through Spring 2016 (twelve academic semesters), the S-STEM Scholar Program awarded scholarships to 33 individual students. At the end of the Spring 2016 semester, of these 33 students:

- 12 have graduated from WMU with STEM degrees, and are employed in industry or enrolled in graduate studies
- 6 are still enrolled in the College and are on-track to earn a STEM degree by Spring 2017
- 1 was retained in the College but did not meet cumulative GPA requirements (>2.75) to continue as an S-STEM Scholar. He is on-track to complete a STEM degree Spring 2017.
- 1 has graduated from the University with a non-STEM degree
- 4 are currently retained at the University but in non-STEM majors
- 1 transferred from the University due to an athletic scholarship opportunity elsewhere
- 1 transferred to another University in a STEM major
- 2 left the University for unknown reasons
- 5 left the University as a result of poor academic performance

Thus, 57.6% of S-STEM Scholars (19 of 33) have either graduated or been retained in the College. In comparison, the College's First Year Engineering Experience (FYEE) Program (which supports retention of 1st- and 2nd-year students) had 62.2% retention after Year 1 (return to the College for a second year of classes); 49.0% retention after Year 2; 45.0% retention after Year 3; and 42.1% after Year 4 (which includes students who graduated), for students starting in Fall 2010 (347 students in cohort).[3] For students starting at WMU in the College in Fall 2011 (296 students in cohort), retention to the College after Year 4 (which includes students who graduated), was similar, at 44.3%.[3] For students starting at the College in Fall 2012 (293 students in cohort), retention to the College after Year 4 (which includes students who graduated), was 49.5%.[4] Seven students of the 33 S-STEM Scholarship recipients (21.2%) have left the University and were not known to have continued their education elsewhere. When comparing the S-STEM Scholars retention rate after Year 4 in the College after the Spring 2016 semester (57.6%) to the College as a whole (42.1%, 44.3%, 49.5%; mean of 45.3% over three student cohorts), the S-STEM Scholars have had a higher retention rate than students in the College in general.

Similarly, the retention rate after Year 4 to WMU as a whole after Spring 2016 for students having graduated or who are still enrolled[3] is 59.1%. The S-STEM Scholar program has retained to WMU a total of 24 of 33 students over time, for a 72.7% rate, which again exceeds the comparison group average. This retention rate comparison shows that the S-STEM Scholar program retained students to the College and to the University at a higher rate than the general student population, which is an answer to **Research Question 2.**

Time to Degree for S-STEM Scholars

As of the end of the Spring 2016 semester (end of Year 6), twelve of the S-STEM Scholars have graduated from WMU with a STEM degree. In total, they were enrolled for 103 semesters, for a mean of 8.6 semesters per student to complete their bachelor's degree. When compared to the College average of 10.5 semesters stated earlier, the S-STEM Scholars completed their undergraduate STEM degree at a faster pace, which is an answer to **Research Question 3.**

Key Outcomes

S-STEM Scholar students had a higher retention rate than other students enrolled in the College (57.6% versus 45.3%) or in the University as a whole (72.7% versus 59.1%), (Research Question 2). S-STEM Scholar students completed their bachelor's degree programs in less time than other students enrolled in the College, in an average of 8.6 semesters instead of 10.5 semesters (Research Question 3). Nearly 100% of the S-STEM Scholar students engaged in professional development activities (Research Question 4). When including summer research opportunities, 57.6% of the S-STEM Scholars participated at least once in a summer internship, summer research experience, or co-op opportunity while enrolled in their undergraduate degree program (Research Question 5).

The project objectives stated earlier were achieved as the availability of the S-STEM scholarship funds allowed students to complete their degree programs sooner than their peers (relates to Objective 1). Professional development opportunities were available, and all S-STEM Scholar students took part in them through a combination of participating in scheduled S-STEM Scholar events, student organizations, performing research, or preparing for and obtaining internships or co-ops. Several students have chosen to continue their STEM education as graduate students (Objectives 2 and 3).

Lessons Learned During the S-STEM Scholars Project

The faculty investigators unexpectedly found that it is difficult to get students to commit to professional events such as off-campus plant tours. The S-STEM Scholars were very active in student organization events and elected officer positions, but most were not willing to commit additional time to off-campus events. This difficulty in motivating students to participate included having S-STEM Scholars attending regional or national professional conferences, as an opportunity to learn more about their future professions, or to present the results from their undergraduate research projects. The S-STEM Scholars generally preferred to attend the smaller regional conferences, which required a time commitment of a Friday and Saturday, instead of a national conference, which usually required a commitment of Sunday through Wednesday.

The S-STEM Scholars were very willing to participate in resume and interview skill workshop events (evening events organized by project faculty; others offered through the College advising office; or student organizations) and College or University Career Fairs. They could see the direct benefit to themselves with a near-term target of finding summer internships or full-time employment.

Additional self-awareness or self-reflection components should be built into scholarship and mentoring programs of this type and on multiple time frames during the program to keep the students motivated towards seeing the connection between the program objectives and their long-term professional success. The program objectives were presented and discussed with the students on multiple occasions, but a greater understanding and internalizing of the objectives might have been achieved by incorporating additional written self-reflection assignments.

A student's financial situation changes from year to year and semester to semester more rapidly than expected. The use of FAFSA scores as one qualifier for an S-STEM Scholarship award was beneficial. Greater flexibility in the amount of the scholarship award made to an individual student began in Year 3 (while staying within the grant guidelines) in an effort to address this.

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