Effectiveness of A Scholarship Program to Increase Retention in Engineering

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Abstract

From fall 2012 through spring 2017, students at the University of New Haven have received S-STEM support from A Scholarship Program to Increase Retention in Engineering (ASPIRE): Improving Work-Study-Life Balance. The goal of the program was to increase retention of sophomore and junior engineering students who show academic promise but are at risk of not completing their studies due to financial concerns and/or life-work-study balance issues. In addition to financial support, ASPIRE provided scholarship recipients with opportunities to participate in activities that contribute to persistence such as tutoring, faculty mentoring, conferences, presentations and career planning workshops. Sixty-one students have been awarded scholarships in this five-year period.

This paper examines the effectiveness of ASPIRE to help students alleviate financial concerns and better manage their life-work-study balance for the five cohorts that have been supported by this NSF S-STEM program. Student demographics are summarized along with graduation rates. A description of the support activities is provided and their contribution to retaining students in engineering is discussed. The value of the financial support and ASPIRE related activities is assessed using a survey and student reflections. The paper concludes with lessons learned through implementation of this program.

Background

Beginning in fall 2012, the University of New Haven has offered financial support to academically promising sophomore and junior engineering and computer science students through *A Scholarship Program to Increase Retention in Engineering (ASPIRE): Improving Work-Study-Life Balance*. This five-year grant funded by NSF S-STEM provides support to students who demonstrate academic potential but are at risk of not completing their studies due to financial concerns and/or life-work-study balance issues. With an overall goal of improving student success to graduate and pursue a career in a STEM field, the program in addition to financial support provides students opportunities to participate in complementary and supplemental activities that contribute to persistence. Achievement of this goal is based on the following objectives:

1. Provide scholarships for matriculated students based on both financial need and merit to sophomore and junior level students over five years.
2. Recruit and provide scholarships to high academic performing community college transfer students over five years.
3. Provide support services that include engineering tutors to complement the current university-tutoring center.
4. Increase student engagement in college- and university-wide activities that contribute to persistence such as mentoring STEM students, participating at academic conferences in their field, service learning activities, and graduate and professional networking events.

The application and selection process for receiving ASPIRE scholarships were described in a previous conference proceeding (1). In addition to scholarships, bridge funding in the amount of $3000 was available each year to support students who had a change in financial circumstances such as an unanticipated financial crisis, or loss of employment by parents or students. Allocation of bridge funding was dependent on financial eligibility of the student.

The ASPIRE Program leveraged the success of existing activities at the University of New Haven to provide recipients with complementary and supplemental support activities that included: mentoring, undergraduate research opportunities, networking with alumni, applying to graduate school, and opportunities to participate in service learning projects (1). Regardless of whether scholarship recipients were receiving financial support from the grant, students had access to these opportunities until they graduated.

The broader impact of the project includes: increasing diversity by recruiting community college transfer students; improving STEM exposure to middle and high school audiences through the scholarship program's service learning activities; strengthening collaborations with industry for internships and career planning; and developing student support services that ultimately benefit the broader student body as well as the scholarship recipients.

Program Evaluation and Assessment

The overall goal of ASPIRE was to improve the success of academically deserving sophomore and junior level students at the University of New Haven who were struggling to finance their education (1). Measures of project success were defined by whether financial support provided by the scholarship allowed students to complete their degree program within 4-5 years (or 8-10 semesters) and whether this enriched students' educational experience. Persistence and completion of degree were measured using data that included retention rate, number of credits/year, GPA and time to graduation. Data on level of engagement both externally and internally to the university were used to measure whether students' academic experience was enhanced.

An evaluation plan created by the PIs, with assistance of the external evaluator of the grant, uses a pathway model approach (1) that maps how activities in the ASPIRE program support short term, medium term and long term outcomes and how outcomes at one level support outcomes at a different level. Data was collected to assess outcome measures of retention rate and support services that include the following:

- increase in retention rate;
- increase in number of credit hours/year;
- decrease in time to graduation;
- increase in GPA;
- increased engagement in university extracurricular activities;
- increased engagement with students and faculty.

Level of engagement was assessed using a survey created by the PIs to evaluate how the scholarship impacted students educational experience. The ASPIRE Evaluation Survey

combined questions/statements related to financial impact of the scholarship and support activities supported with ASPIRE funds, with questions modified from the Persistence in the Sciences (PITS) assessment survey (2). Recipients were not offered any incentives to complete the survey. Statements/questions in this survey are outlined in Appendix A.

The first part of the survey was designed to gain insight as to the impact of financial support for scholarship recipients as well as level of engagement and benefits of the supplemental activities offered by the program. Students were asked to complete statements related to impact of financial support, whether work hours were reduced, whether they participated in specific ASPIRE sponsored activities, and benefits of participation in those activities on their educational experience by selecting appropriate choices. There were opportunities for students to provide reasons why they didn't participate in supplemental activities, as well as to give feedback regarding the ASPIRE Scholarship Program.

To gain further insight as to whether the scholarship program contributed to students' persistence in STEM, questions from the PITS assessment survey were included in the ASPIRE Evaluation Survey. The PITS survey was originally designed to measure the psychological outcomes of undergraduate research experiences relevant to persistence in STEM. The survey was modified for the ASPIRE Program by excluding two of the components; that is, project ownership content and scientific community values. Students were asked to rate the extent to which they agreed with statements pertaining to words that described their experience with the scholarship (emotions); confidence in their abilities to function as an engineer/scientist (self-efficacy); sense of themselves as engineer/scientist (identity); and dealing with discussion of the scholarship (networking).

Overview of ASPIRE Cohorts

From fall 2012 through spring 2017, ASPIRE Scholarships were awarded to a total of 61 students in five cohorts. With the exception of the first year, the selection process was made during the spring semester. For this reason, the cohorts were identified by spring semester; namely 2013, 2014, 2015, 2016 and 2017. With decisions made at the end of 2012, over half of the students in the initial cohort (2013) received funding only for the spring semester. The number of students in each cohort follows: 8 students in 2013 cohort; 15 in the 2014 cohort; 24 in 2015 cohort; 29 in 2016 cohort and 38 in 2017 cohort. These numbers reflect that some students were in multiple cohorts.

Summarized below is demographic information relating to the ASPIRE Scholarship recipients across all five cohorts.

- 30% of the awardees were female;
- 34% of awardees self-identified as belonging to an underrepresented ethnic group (18% African-American and 16% Hispanic);
- Distribution of majors: 20 Mechanical Engineering, 15 Civil Engineering, 10 Electrical Engineering, 7 Chemical Engineering, 3 Computer Engineering, 2 Computer Science, 2 Cyber Systems, and 2 System Engineering;
- 2017 cohort average GPA at time of award 3.25;

- 2016 cohort average GPA at time of award 3.27;
- 2015 cohort average GPA at time of award 3.42;
- 2014 cohort average GPA at time of award 3.0;
- 2013 cohort average GPA at time of award 3.33.

This data provides evidence that the ASPIRE Program has been successful in increasing support for underrepresented students in engineering. Inclusion of 34% African-American and Hispanic students and participation of 30% females is above the demographics for the College of Engineering.

Effectiveness of Scholarship Program

The effectiveness of the ASPIRE Scholarship Program was defined by whether financial support provided by the scholarship allowed students to complete their degree program within 4-5 years (or 8-10 semesters) and whether supplemental activities enriched students' educational experience. Data collected to assess persistence and completion of degree included retention rate, number of credits/year, GPA and time to graduation.

ASPIRE Scholarships were awarded to engineering and computer science majors in their sophomore and junior years of study, although students could participate in supplemental activities through graduation. Approximately 43% of the recipients received the scholarship their sophomore year and were eligible for multiple years of support. Of the 61 students who received ASPIRE Scholarships, only 1 switched majors to a non-engineering field after receiving the award and 95% were retained in the Tagliatela College of Engineering.

A requirement of the scholarship was that students had to maintain full time status; that is, credit load of 12-17 credits per semester. Engineering and computer science curriculum is designed such that students take 15-17 credits each semester throughout the four years to complete the degree. Only twice were students not eligible to receive ASPIRE funding in a particular semester because they registered as part-time student or had a leave of absence (military commitment).

Data collected for NSF on the scholarship recipients indicated that the overall GPAs of students receiving the scholarship did not significantly change during the time they received ASPIRE funding. Many of the students who received the scholarship were academically strong students as evidenced by an average GPA of the cohorts of 3.0 or above for all five years of the program.

Graduation rate of ASPIRE recipients was quite high. To date, 35 students who received funding graduated in four years, representing 92% graduation rate for those students eligible to graduate in four years. Included in this graduation rate were three students who transferred into the university with 48 credits or more and graduated in three years, and one transfer student who took four years to complete the degree. In spring 2018, 12 more recipients will graduate, having completed their degrees in four years, with the exception of one student who will take five years to complete the degree requirements. Of the remaining 10 ASPIRE recipients, all are on target to graduate, completing their degrees within five years.

The ASPIRE program was designed with the goal of improving in our students the following four attributes:

1) the financial stress of education,
2) the part-time work commitment for tuition,
3) enhancing the amount of time students are on campus, and
4) having the students feel a more significant connection to the field.

Through the ASPIRE Evaluation Survey, each of the four attributes was measured for effectiveness. Results presented are based on 67% of the ASPIRE recipients completing the survey.

Financial Stress of education

With our students attending a private university with tuition of over $35,000, the majority of students are burden with how they will be paying for their education currently and in the future. The ASPIRE scholarship was never going to be able to provide a tuition-free experience but could give some relief. The maximum a student could receive from the ASPIRE scholarship was $8,750 (approximately 25% of tuition). The impact the financial assistance provided varied based on the students' financial situation. Our goal was to ease the stress that the financials were instilling in the student.

To measure the effectiveness of easing financial stress we asked our students in the ASPIRE Evaluation Survey whether the ASPIRE scholarship allowed them to:

a) reduce the number of hours worked (29% of students said yes)
b) reduce the amount of loans taken out (84% said yes)
c) reduce their family's financial contribution (66% said yes)
d) had no financial impact (0% said yes)

The results of the survey did show that the ASPIRE scholarship was effective in reducing the financial stress. Anecdotally, through our advising and talking with students we know that the minimum amount we provided was able to help them continue to attend university and allow students to pay their bill promptly to avoid being placed on a financial hold that could affect their ability to register for classes.

Part-time Work Commitment

A common trend the engineering faculty notice over the years has been the increase in students working part-time jobs to help pay their tuition. The impact of part-time work can cause adverse effects with students missing class or not having time to study. Some part-time work can be beneficial with improving their education such as an internship.

We had determined that a student receiving the maximum award of $8,750 was equivalent to working around 875 hours at a minimum wage part-time job. We hoped that the scholarship award would be viewed by the student as a replacement for working. We asked the ASPIRE recipients the effect of the scholarship on part-time work. The results were as follow:

a) 5% were able to stop working
b) 13% were able to cut working 1 to 3 hours each week
c) 11% were able to cut working 7 to 9 hours each week
d) 8% were able to cut working 10 or more hours each week
e) 29% stated the ASPIRE did not affect the number of hours worked

The ASPIRE students also commented on the survey that 34% of recipients were able to switch from retail jobs to jobs that were in their chosen field (i.e., internship). While those students were working, the educational benefits were essential to their further development.

Time on Campus

By reducing the hours students need to work, more time should be available for them to study and engage more in the life of the university. Participation in university-wide activities and clubs helps to foster connections to the university that impact retention, as well as sense of identity in their chosen field of study.

We asked students in the survey to rate their level of agreement with whether the scholarship allowed them more time for certain opportunities. The results were as follow:

a) more time for studying (71% agreed or strongly agreed)
b) more involved in clubs and other university-wide activities (68% agreed or strongly agreed)
c) more time on campus (64% agreed or strongly agreed)
d) opportunity to engage in research on campus (55% agreed or strongly agreed)
e) ability to become a tutor on campus (34% agreed or strongly agreed)

Survey results also indicated that 34% of the recipients felt the scholarship allowed them added flexibility for scheduling classes since they were not burdened with fitting classes around their work schedule.

When asked to provide feedback on the scholarship program, a student commented:

> *"Thank you for choosing me for the scholarship. It was great in taking a financial burden off of me and let me focus on school and being part of the university community."*

Connection to Engineering Field

In addition to financial support, the ASPIRE Scholarship Program provided students with opportunities that contribute to persistence such as participating at academic conferences in their field, service learning activities, and graduate and professional networking events. To measure the effectiveness of these opportunities in enhancing students' educational experience, questions directed at the benefits of specific activities were included in the survey. Participation in these opportunities were not mandatory, but rather open to all scholarship recipients even after the financial support discontinued.

An Alumni Networking event was held 3 of the 5 years ASPIRE funding was available. Survey results indicate that 41% of the ASPIRE students attended one or more of these events. Many of

the students who did not attend indicated time conflicts/commitments or not being geographically in the area as to reasons why they did not participate. When asked in the survey whether the Alumni Networking event was beneficial to them, students selected the following reasons:

a) received advice on applying for jobs (80%)
b) received advice for interviewing (47%)
c) made contacts for future jobs (40%)
d) provided better understanding of entry level engineering or computer science position (87%)
e) helped to learn about benefits of a graduate degree (27%)
f) provided me with job opportunities (13%).

One of the students commented:

> *"The scholarship towards tuition is extremely helpful to pay for school, but the Alumni dinner is invaluable. It really helped give me the confidence I needed to see peers not much older than me succeed, and to hear their advice on how to get there. And now as an alumnus who is succeeding in the field of engineering, I love being able to share what I've learned and help others."*

A unique opportunity ASPIRE funding provided was the ability for students to attend professional conferences. Nearly half of the students (49%) responded in the survey that they took advantage of ASPIRE funds to attend conferences. Students selected the following benefits of attending a conference:

a) received advice on applying for jobs (73%)
b) received advice for interviewing (67%)
c) provided job opportunities (61%)
d) helped when applying for jobs (44%)
e) helped when applying for graduate school (17%)

A student commented in the survey:

> *"The funds from the ASPIRE Scholarship enabled me to explore research in the form of two academic conferences during my junior year. These two conferences have undoubtedly changed my life and provided me with a level of experience and confidence to succeed in my current graduate research".*

With financial support provided by the ASPIRE Program, students were able to attend conferences hosted by professional societies such as SWE and Pi Tau Sigma, and research focused conferences. For some of these students, it was the first time they attended a conference, while for others, students participated in poster sessions and oral presentations. The impact of these experience is captured in the following quotes taken from reflections students were asked to write upon returning from the conference.

> *"One workshop in particular that I attended dealt with conversations about challenges*

that accomplished professional engineers have faced in the past both in pursuing their engineering degrees as well as in starting their careers. Many of these professional engineers working for companies such as NASA, IBM, Apple, etc. talked to the students on an authentic level about difficult obstacles they have had to overcome, classes that they had to retake, professors that falsely suggested that they change their major just because times became difficult, etc. However, they encouraged the students to not let small hurdles deter us from pursuing our engineering careers as they too struggled once before but it shaped them into the resilient professionals that they are today."

"Overall, this conference was extremely rewarding. I was able to learn the true meaning of networking, the importance of a solid resume, communication skills and what future holds in my major. … At this conference I learned that my major is not just building bridges and roads. It opened my eyes to what other great things Civil Engineers can contribute to. Also at this conference I was able to realize and think more about my future as a working engineer and building a family."

One student who attended conferences commented:

"From attending these conferences, I have been able to strengthen my resume, speaking and interview skills, and network. I believe that by attending these conferences I have grown as an engineer and gained valuable knowledge I would not have otherwise acquired".

Another student who presented at multiple conferences commented:

"Attending both conferences was an experience that I highly value. I was able to meet new and interesting people which allowed me to make connections. It was also interesting to learn about the things others like me had researched. … This research experience really opened up many doors for me and it has also made me think about grad school. I had planned to not attend graduate school until later on, but going through this research process I have changed my decision."

It's evident from these comments as well as the survey results that the experience of attending a conference greatly enhanced these students' educational experience, and in some cases, impacted their future career plans.

A feature of the ASPIRE Program was mentoring provided by the PIs that supplemented students assigned faculty advisors. ASPIRE mentors encouraged students to participate in supplemental activities supported with ASPIRE funding and campus-wide programs to enhance students educational experience such as the Summer Undergraduate Research Fellows program. These mentors also provided scholarship recipients with career advice and guidance on job-related decisions.

We asked students in the survey to select how the mentoring received from the faculty mentors of the ASPIRE program helped them. The results were as follow:

a) helped me when I applied for graduate school (21%)
b) made me aware of research opportunities on campus (53%)
c) made me aware of opportunities for service learning projects on campus (26%)
d) helped me when applying for opportunities on campus to work including tutoring (35%)

About 15% of the students responded that the mentoring was limited and a couple of students indicated that they were not made known that mentoring was available.

One of the questions in the survey asked students to rate the level to which they agreed or disagreed with statements concerning their sense of themselves as an engineer/scientist. Students responded that they strongly agreed or agreed to the following statements:

a) I have a strong sense of belonging to the community of engineers/scientists (73%)
b) I have come to think of myself as an 'engineer'/'scientist' (85%)
c) I feel like I belong in the field of engineering/science (88%)
d) The daily work of an engineer/scientist is appealing to me (91%)

These results suggest that ASPIRE students were connected to their discipline and have developed a strong identity to engineering and computer science. Although the ASPIRE Program alone can not be credited for developing this identity, certainly the results of this survey support the assertion that the program contributed to ASPIRE recipients sense of identity as an engineer/scientist and their connection to the field.

Lessons Learned

The ASPIRE program was the first time for all of the PIs' to be running a scholarship program that was not aimed at just providing funds but making an impact to the educational component of the students' time at the university. At the end of the ASPIRE program, there were many lessons that we learned that we could have used at the start of the program to provided additional support.

One of our goals in the ASPIRE program was to have the student have a better feel to being connected to the engineering/science field. Our results showed that at the end of the program the vast majority of students did come out feeling connected.

The most effective activities we provided were the Alumni Dinner and the conference travel support. We knew the activities would be well liked but did not judge the meaningful impact it would have on the students that participated. It was disappointing to read in the survey results that some of the students were unaware of these two high impact activities. If done again we would have just used testimonies as the advertising focus instead of an email as the way to inform students.

Not all students benefitted from the program since time commitments interfered with their ability to participate or they chose not to participate. However, supported by the results is that those students who participated in supplemental activities benefitted greatly. The PIs suggest to

improve the effectiveness of such programs, students should be required to participate in at least some level of activities.

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Appendix A: ASPIRE Evaluation Survey

We are interesting in understanding the impact the ASPIRE SCHOLARSHIP had on you.

1. Please select all that apply in completing the following statement.
Money received from the ASPIRE Scholarship allowed you to ...

a. Reduce the number of hours worked
b. Reduce (or change) the amount of loans taken
c. Reduce my family's financial contribution
d. Had no financial impact
e. Other (fill in box)

2. We are particularly interested in understanding the impact on your work hours. Please select which of the following applies in completing the following statement.
Receiving the ASPIRE SCHOLARSHIP allowed you to ...

a. stop working
b. work more in my chosen field rather than unrelated work; e.g. retail.
c. work 1-3 hours less per week
d. work 4-6 hours less per week
e. work 7-9 hours less per week
f. work 10 or more hours less per week
g. no effect

3. In the time you received ASPIRE SCHOLARSHIP, how many times did you experience financial holds in your Bursary Account? If so, please describe the situation.

4. The ASPIRE SCHOLARSHIP was beneficial as a talking point in the following situations ... (select all that apply)

a. helped when applying for other scholarships
b. came up during job interviews
c. listed on my resume
d. Other (please specify)

5. Indicate your level of agreement with the following statements: Receiving the ASPIRE SCHOLARSHIP allowed you ...

	SA	A	N	D	SD
a. more time for studying					
b. to be more involved in clubs and other university-wide activities.					
c. more time on campus.					
d. the ability to become a tutor on campus.					
e. added flexibility for scheduling classes.					
f. the opportunity to engage in research on campus.					

6. Did you attend the annual Alumni * Networking Event?

- yes
- no

7. If yes, attending one of the Alumni Networking events was beneficial to me because ... (select all that apply)

a. I received advice on applying for jobs.
b. I received advice for interviewing.
c. Provided me with job opportunities.
d. Made contacts for future jobs.
e. Provided better understanding of entry level engineering or computer science position.
f. Helped to learn about benefits of a graduate degree.
g. Other (please specify)

8. If not, would you share with us why you did not attend the annual Alumni Networking event?

9. Did you take advantage of the funds available to * attend conferences?

- yes
- no

10. If yes, please select all that apply in completing the following statement:
Attending a conference was beneficial to you because ...

a. received advice on applying for jobs.
b. received advice for interviewing.
c. provided job opportunities.
d. Helped when applying for jobs.
e. Helped when applying for graduate school.
f. Other (please specify)

11. If not, could you tell us why you didn't take advantage of the funds available for travel to conferences?

12. Select all that apply in completing the following statement:
The mentoring I received from the Faculty Mentors of the ASPIRE Program ...

a. helped me when I applied for graduate school.
b. made me aware of research opportunities on campus.
c. made me aware of opportunities for service learning projects on campus.
d. helped me when applying for opportunities on campus to work including tutoring.
e. was limited.
f. Other (please specify)

The next few questions are taken from standardized surveys. Your responses will allow us to

compare responses to other published results.

13. In the table below you will find 5 different emotion words from a standardized emotion index. Think about the ASPIRE SCHOLARSHIP. Please indicate the extent to which each word describes your experience with the scholarship.

	SA	A	N	D	SD
a. delighted					
b. happy					
c. joyful					
d. amazed					
e. surprised					
f. astonished					

14. Rate the degree to which you agree or disagree with the following statements concerning your confidence in your abilities to function as an engineer/scientist in your area.

	SA	A	N	D	SD
a. I am confident that I can use technical skills (use of tools, instruments, and techniques)					
b. I am confident that I can generate a research question to answer.					
c. I am confident that I can identify a problem to solve.					
d. I am confident that I can figure out what data/observations to collect and how to collect them.					
e. I am confident that I can use scientific literature, reports, and standards to guide my research.					
f. I am confident that I can use scientific literature, reports, and standards to guide my design solutions.					
g. I am confident that I can develop theories (integrate and coordinate results from multiple sources/studies)					

15. Rate the level to which you agree or disagree with the following statements concerning your sense of yourself as an engineer/scientist.

	SA	A	N	D	SD
a. I have a strong sense of belonging to the community of engineers/scientists.					
b. I derive great personal satisfaction from working on a team that is doing important work.					
c. I have come to think of myself as an 'engineer' / 'scientist'.					
d. I feel like I belong in the field of engineering/science.					

e. The daily work of an engineer/scientist is appealing to me.

16. Rate the degree to which you agree or disagree with the following statements dealing with the discussion of your scholarship:

	SA	A	N	D	SD
a. I have discussed my ASPIRE SCHOLARSHIP with my parents (or guardian)					
b. I have discussed my ASPIRE SCHOLARSHIP with my friends.					
c. I have discussed my ASPIRE SCHOLARSHIP with students who are not in my class but are in my university					
d. I have discussed my ASPIRE SCHOLARSHIP with students who are not at my university					
e. I have discussed my ASPIRE SCHOLARSHIP with my professors.					
f. I have discussed my ASPIRE SCHOLARSHIP with professors who are not my course instructors.					

17. We would like to stay in contact with each of you and check-in in about a year to find out what you are up to. Please provide us your name and email where we can reach you.

Name:
Email:

18. Any additional comments or feedback regarding the ASPIRE SCHOLARSHIP.