The Liberal Arts Science Scholars Program: A Multidisciplinary Model for Supporting Science and Mathematics Students through the First Year

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Abstract

St. Lawrence University received a five-year Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM) award from the National Science Foundation (NSF) to create the multidisciplinary Liberal Arts Science Scholars program (award #1458712), which makes a high quality science and mathematics education accessible to high achieving, Pell Grant eligible students by providing merit scholarships and specialized supports. The program's supports, which are not specific to any one discipline, are designed to combat three of the main barriers to STEM persistence: capacity, interest, and belonging. This paper describes the first year of the Liberal Arts Science Scholars program and provides preliminary evidence for the program's ability to serve as a model for improving the retention and academic success of low-income students in the natural, physical, and mathematical sciences. While the Liberal Arts Science Scholars Program was implemented at a small, private liberal arts university, the supports described could be adapted for use at any type of institution.

Introduction

The demand for workers that can contribute to the nation's STEM workforce is growing (Carnevale, Smith, & Strohl, 2013; Carnevale, Jayasundera, & Gulish, 2016). In their 2012 report, the President's Council of Advisors on Science and Technology (PCAST) noted this growing need for STEM professionals but also found that, at the present rate, the United States is not on track to meet this need. They note that, currently, only about 40% of students who enter college planning to major in a STEM field complete a STEM degree (p. 5). PCAST (2012) identified the first two college years as critical to STEM persistence and retention. Funded by the National Science Foundation (NSF) through the Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM) program, the Liberal Arts Science Scholars program at St. Lawrence University provides a model to increase the accessibility of a college education for high-need students interested in the natural, physical, and mathematical sciences (henceforth referred to as "science and math") and support them through their early years in college.

While careers requiring education beyond high school are growing in number, the cost of college education is on the rise (Seltzer, 2017). These rising costs can create a barrier preventing low-income students from pursuing a college education. The NSF S-STEM program is one mechanism for increasing the number of low-income students in the STEM pipeline[1]. Broadly, the goals of the NSF S-STEM program (NSF, 2012) are "1) improved educational opportunities for students; 2) increased retention of students to degree achievement; 3) improved student supports; and 4) increased numbers of well-educated and skilled employees in technical areas of national need." Under solicitation NSF 12-529, the S-STEM program was primarily a scholarship program, and it was expected that scholarship recipients achieve at least one of the following outcomes (NSF, 2012): "1) receive an associate, baccalaureate, or graduate degree in one of the S-STEM disciplines; 2) transfer from an associate degree program to a baccalaureate degree program or from an undergraduate program to a graduate program in one of the S-STEM disciplines; and/or 3) successfully pass one or more of an institution's self-identified attrition points."

If institutionally appropriate supports are implemented, merit-based scholarship programs, such as the NSF S-STEM program, can be an effective way to increase STEM retention and persistence among low-income students. Examples include "bridge" programs (Kalevitch et al., 2012; Kalevitch, Maurer, Badger, Holdan, & Sirinterlikci, 2015; Onoye & Bong, 2017), learning communities (Gross, Iverson, Willett, & Manduca, 2015; Piper & Krehbiel, 2015; D'Souza, Shuman, Wentzien & Roeske, 2018), summer research experiences (Gross et al., 2015), career exploration seminars and professional development (Medsker et al., 2016; Onoye & Bong, 2017), and peer/faculty mentoring (Kalevitch et al., 2012; Kalevitch et al., 2015; Gross et al., 2015; Piper & Krehbiel, 2015; Onoye & Bong, 2017; D'Souza et al., 2018).

The Liberal Arts Science (LAS) Scholars Program at St. Lawrence University aims to make a high quality liberal arts science and mathematics education accessible to talented, low-income (Pell-eligible) students from backgrounds traditionally underrepresented in STEM fields (women, first generation college students, and racial and ethnic minorities), by providing enhanced educational opportunities, significant faculty mentoring, and additional funding through the NSF S-STEM program (award #1458712). The program is designed to shepherd students through the first year and ease them through the transition to a science or math major using supports designed to address three of the main barriers to STEM persistence: capacity, belonging, and interest (Packard, 2016).

This paper describes the program's first year supports and how they address the main barriers to persistence in STEM. We present retention data and findings from surveys, as well as data on academic performance and from focus group discussions, to support this model's potential for improving the retention and academic success of low-income students in science and math. The program described in this paper was implemented at a small, private liberal arts college, but the program's most promising components – a community-building orientation, cohort courses that cut across disciplinary boundaries and emphasize skills needed across science and math fields, and close, meaningful connections with faculty mentors – could be adapted for or implemented at any other type of institution.

The Liberal Arts Science Scholars Program at St. Lawrence University

St. Lawrence University (SLU), chartered in 1856, is the oldest continuously coeducational institution of higher learning in New York State, and today is an independent, private, non-denominational, small liberal arts college. SLU offers 69 majors, 40 minors, 3 graduate

1. It is important to note that the NSF S-STEM solicitation, and thus the expectations for S-STEM programs, has changed over the years. This project was funded under solicitation NSF 12-529 (National Science Foundation [NSF], 2012). More recent solicitations require that projects include a research study (separate from program evaluation and assessment) that will advance understanding about retention, success, and degree attainment for low-income students; this requirement was not present in NSF 12-529.

programs in education, 27 off-campus study programs in 20 countries, and 5 off-campus programs in the U.S. to a population of 2,414 undergraduates (44% men and 56% women). In 2017-2018, SLU students represent 43 states and 53 foreign countries: 33.8% New York State; 57.6% U.S., non-New York State; and 8.6% from outside the U.S. Currently, 100% of undergraduates receive financial aid (need or merit based). Over the past five years, 18-20% of students who have matriculated at SLU have been Pell Grant recipients, and 8-17% have been first generation college students. Within a year of graduation, 97% of SLU students are employed or enrolled in graduate or professional schools, and 47% of students pursue an advanced degree within five years of graduating.

In March 2015, SLU was awarded an NSF S-STEM grant (#1458712) to create the Liberal Arts Science (LAS) Scholars program to support low-income students with intended majors across all St. Lawrence science and math fields (biology, biochemistry, chemistry, computer science, conservation biology, geology, mathematics, neuroscience, physics, and statistics). The proposed program design was two cohorts of 10 Scholars each (Cohort 1 in 2015-2016 and Cohort 2 in 2016-2017). The program proved popular, and more students accepted offers for a position in the first cohort than the 10 originally anticipated, so the actual cohort sizes were 14 and 8, respectively.

Due to the timing of the award notification, we were only able to recruit for the LAS Scholars Program from the students who had already been accepted to SLU. To do so, we encouraged all accepted incoming students who met the necessary qualifications to apply for a spot in the program. These qualifications were

1) Demonstrate significant financial need (Pell eligi bility);
2) Express interest in pursuing a (non-health) major in a science or math field;
3) Show significant academic aptitude and intel lectual potential (eligible candidates have a me dian GPA of at least 91, SAT median of at least 1300, or an ACT median of at least 28); and
4) Meet the NSF's citizenship requirements.

To apply for the program, eligible students were invited to submit an application that included a 250 word essay responding to one of several prompts. The possible prompts were

1) "What event or experience led you to be interested in STEM?"
2) "Describe an aspect of STEM that fascinates you, and explain why. This could be a field, an experi ence, a famous scientist, an equation – whatever interests you most."
3) "What are your career interests, or what potential future do you see for yourself in STEM?"

These open-ended questions accommodated applicants' diverse interests and allowed them to express their engagement with and passion for science and math fields; essays were assessed primarily for the applicant's enthusiasm in and perceived commitment to their intended science or math field.

Scholars selected for the program receive a scholarship of $6,500 per year for up to four years (in addition to any financial aid provided by the institution), as long as they meet the two program requirements. The program requirements are:

1) be either (a) an undeclared major (during the first two years at SLU) or (b) a science or math major with a non-health track. Any Scholar can choose to double-major, as long as one major is in science or math; and
2) have a cumulative GPA not less than 3.0 on SLU's 4.0 scale. Any Scholar that falls below the 3.0 GPA threshold has four semesters to restore their GPA.

When recruiting for the first year of the program, the SLU Admissions Office identified a pool of 79 students who met the program's eligibility requirements. All 79 were invited to apply for the program, and we received applications from 29 students. After reviewing applications, offers for a position in the program were made to 17 students, and 14 ultimately accepted those offers. In the second year, the Admissions Office identified 67 eligible students, all of whom were invited to apply. We received 20 applications, and we made 9 offers, with 8 students accepting the offer.

The application review process tended to focus on the degree to which students conveyed an enthusiasm for a STEM field in their essay and was not specifically tied to previous academic performance. The most common reasons that students who applied were denied a spot in the program were an expressed interest in a health career (not supported by the NSF S-STEM program) or an expressed interested in a field not considered STEM by the NSF (e.g., Environmental Studies). High school class percentile (class rank divided by class size) of applicants (which is submitted by only about one third of high schools) provides an imperfect, but potentially informative, measure of academic performance prior to acceptance into the program. From the first cohort, the high school class rank for the students offered a spot in the program ranged from 0.8 – 22.8 (4 missing values) and the rank for those not offered a position ranged from 0.3 – 15.6 (3 missing). From the second cohort, high school class ranks ranged from 0.6 – 23.1 (3 missing) and 3.5 – 25.3 (5 missing) for those offered a position in the program and those not, respectively. We cannot know for certain why some eligible students chose not to apply for the program, but we suspect that some were interested in a health career and some were no longer interested in attending SLU.

All Scholars in the program belong to one or more of the following groups traditionally underrepresented in STEM fields: females, first generation college students, and students of color. Further, both cohorts of Scholars were comprised of a higher proportion of females and first generation college students than the overall SLU population. Of the 14 students originally enrolled in the first cohort, 11 (79%) were female, 6 (43%) were first generation college students, and 5 (36%) were U.S. students of color. One Scholar (first generation male) left the program midyear and was not replaced since the cohort size exceeded the intended. Of the 8 students originally enrolled in the second cohort, 5 (63%) were female, 3 (38%) were first generation, and 4 (50%) were U.S. students of color. One Scholar (male student of color) left midyear and was replaced by a female, first generation college student. Of the 21 Scholars that completed the first year of the program, 10 (48%) belong to more than one of these underrepresented groups (e.g., female first generation student, female student of color, etc.).

LAS Scholars Program: The First Year

The project's supports address three of the main barriers to persistence in a STEM major: *capacity* to demonstrate competence, interest in STEM ideas, and sense of *belonging* to a STEM community (Packard, 2016). These supports included a program orientation, specially designed cohort courses, and peer and faculty mentoring components. The program's liberal arts setting ensured that Scholars experienced small class sizes, individualized attention, courses taught by STEM faculty members, and support across all aspects of the high school to college transition.

Orientation

A feeling of belonging and connection to peers is as important as the support of teachers for motivation and achievement for young students (Juvonen, Espinoza, & Knifsend, 2012). In their research, PCAST (2012) found that identification with and feelings of belonging to a community of scientists can positively impact STEM persistence (p. 8). To begin building a sense of community, we offered a program orientation, "STEM in the Adirondacks," for each of the LAS Scholar cohorts. This was the first opportunity for the Scholars to meet one another and the faculty mentors in person and allowed us to foster a welcoming and supportive community amongst the Scholars and faculty mentors before SLU's regular first-year orientation.

During the program orientation, both cohorts of Scholars participated in a field trip in the heart of the Adirondacks Mountains. This excursion took the Scholars to several local geologic highlights, as well as a few touristic spots (e.g., the top of Whiteface Mountain, the fifth highest mountain in New York State). On the trip through the Adirondacks, students paddled local rivers, visited State

Parks, and observed local communities. These experiences were used to initiate discussions about socioeconomic factors in the region, the natural history of the region, and the Adirondack Park as a model for the preservation of both public and private land. These discussions emphasized the use of scientific data and methods to address multi-faceted, real-world problems.

The trip also provided the opportunity to get to know the advisors and cohort peers in an informal setting and initiated the formation of a group identity by creating shared experiences. While we implemented many traditional "ice-breaker" activities, we found the organic process of common experiences to be more powerful in developing a close and supportive cohort.

Cohort Courses

A pair of specially designed first year courses formed the foundation of the program's first year. The courses were designed to increase capacity, by instilling basic skills necessary for success in any STEM field; interest, by providing interdisciplinary science and math exposure; and belonging, by creating shared experiences to learn with, and be accountable to, one another.

Scholars entering the program took a 0.25-unit course, titled *Scientific Discovery*, during the fall of their first year. The course allowed students to explore their science and math interests by exposing students to the vast array of forms that science and math research can take, the variety of career opportunities that exist in STEM, and the human element of research (Chen, Hsu, & Wu, 2009; Manchanayakage, 2013; Packard, 2016, p. 15). The course had two goals. The first was to reveal the process of scientific discovery to students via laboratory visits and interactions with active researchers. These researchers also served as role models of people who have found success in science and math careers (Cheryan, Siy, Vichayapai, Drury, & Kim, 2011). A series of short assignments over the semester allowed students to synthesize these experiences while continuing to build connections between the course and the Scholars' broader liberal education. These assignments included response essays, basic graphic design of scientific figures, and brief summaries of primary literature. The course also provided important context to students' other first-year courses in specific disciplines (PCAST, 2012, p. 5; Packard, 2016, p.15). The second goal of the course was to help students build capacity for success in college-level science and math courses by covering effective study and learning habits, with emphasis on the connection between these skills and the learning done by professional scientists.

All SLU students are required to enroll in a First Year Seminar (FYS) in the second semester of the first year. It is in these courses that students get initial exposure to many of the general and transferable skills promoted by liberal education, including inquiry, critical thinking, written and oral communication, information literacy, and synthesis of information (AAC&U, 2007). Over the past five years, only 15% of these seminars have had science and math themes. To fill this niche, we created a STEM-based FYS for the LAS Scholars. The course, titled *Statistical Reasoning and Evidence-Based Arguments*, demonstrates how statistics is used in STEM disciplines and in the general scientific research process. The primary goal of the course is to emphasize and instill skills that are necessary in any STEM field: drawing conclusions from data and multiple forms of scientific communication (Martin & Gaffney, 2016; Tufte, 1997; Zwickl, Leak, & Martin, 2018). As such, the course covered all of the content from SLU's introductory statistics course while simultaneously emphasizing communicating the results of a data analysis (visually, orally, and in written form), using data to support an argument visually and quantitatively, and writing scientific articles. The course's major research and communication assignments included a literature review about a topic on which scientists and the public might disagree (Pew Research Center, 2015) and an empirical research project that required designing an experiment, collecting and analyzing data, writing a scientific paper, and giving a poster presentation.

Mentoring

Mentoring is an important aspect of retaining students in STEM fields (Niemi and Warke, 2011; Landgraf, Salmon-Stephens, & Ul-Haq, 2012; Packard, 2016). To help address our Scholars' diverse academic and social needs, we created a network of faculty and peer mentors. Faculty mentoring builds capacity by advising students to make optimal course choices and helping them develop self-efficacy. Faculty mentors can influence interest through discussions with Scholars about STEM opportunities. Close interactions with faculty members in science and math fields can also increase sense of belonging to a community of scientists. Prior to arrival, each Scholar was assigned a faculty mentor from amongst the program's PI and co-PIs. As much as possible, we matched the Scholars with mentors according to their science and math interests. The small, private liberal arts college setting ensured that Scholars were able to have regular, meaningful interactions with their faculty mentor, as well as other STEM faculty members in their field of interest.

During their first year of study, each Scholar was also assigned a peer mentor. In the first year of the program, the peer mentors were selected from among the undergraduate science and math students at SLU, and in the second year, they were selected from among the first cohort of LAS Scholars. Peer mentors were asked to meet with their Scholars at least once a month during the first year. It was expected that the peer mentoring would be phased out once Scholars declared a major (in the sophomore year), as they should have a large enough network of peers within their majors that they will no longer need regular meetings with a peer mentor.

Primary Findings from the Cohorts' First Years

The LAS Scholars program team has collected data on a number of different metrics that can be used to measure the program's success. Many of these metrics have natural benchmarks or comparison groups rooted in institutional data. Metrics presented include the program's first year retention rates, institutional survey data on sense of science belonging and scientific identity relative to peer groups, and program evaluation by an external evaluator. Together these metrics point toward the potential for the LAS Scholars program to be an effective model for improving retention and persistence in the natural, physical, and mathematical sciences.

Where appropriate, we compare each cohort of LAS Scholars to multiple peer groups. Comparison peer groups consist of the rest of the corresponding first year class partitioned into four groups, according to the interests specified at time of admission to SLU. These comparison groups are: 1) S-STEM eligible (low-income) students who are not in the program, 2) all other first year students interested in science and math, 3) low-income students not interested in science and math, and 4) the remainder of the corresponding first year class.

Retention

As described previously, 91% (20/22) of the students originally selected for the LAS Scholars program completed their first year at SLU and were on track to major in a science or math field, which is comparable to the overall first year to sophomore retention rate at SLU. Both cohorts lost one (male) Scholar mid-year; in the first year the Scholar temporarily left SLU, while in the second year the Scholar switched to a non-STEM major. The Scholar that left from the second cohort was replaced (by a female first generation college student).

Institutional Survey Data

Each spring, SLU invites all first year students to complete our "College Success Questionnaire" (CSQ), which includes questions from national assessment instruments such as the Higher Education Research Institute's (HERI) "Your First College Year" survey (2017), as well as questions specific to the institution. A subset of the HERI questions asks respondents about their associations with science. In examining the responses these questions, we use the science and math comparison groups described above. Further, because these questions were the same for both cohorts, and because there were no changes in the first year of the program specifically or in the overall first year experience at St. Lawrence more broadly, we aggregate the responses across years.

Figure 1 summarizes responses to questions related to scientific identity and belonging for LAS Scholars and

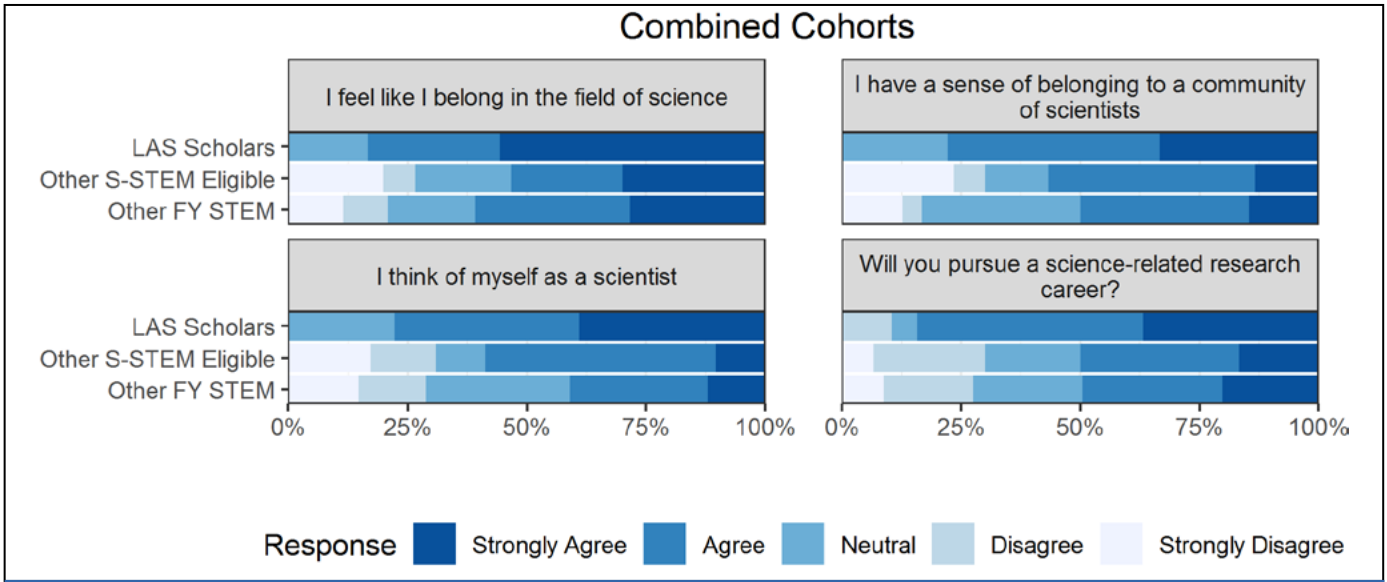

Figure 1: Response summaries for STEM-related CSQ questions for LAS Scholars (cohorts combined) and their relevant STEM peer groups (other S-STEM eligible students not in the program and other first year students interested in science and math). Darker shading indicates stronger agreement.

their relevant science and math peer groups. Scholars were more likely to express a feeling of belonging to the "field of science" and to a community of scientists than their relevant science and math peer groups, as seen in the large amount of darker shading (Figure 1) for those who agree or agree strongly with the survey prompts. They were also more likely to identify as a scientist and indicate that they were likely to pursue a science-related research career. For most survey prompts, the opinions expressed by the Scholars were at least neutral; the only exception occurs for the prompt on a science-related research career. In the case of the latter prompt, one individual per cohort expressed disagreement; it is unclear to which aspect of the question ("science-related" or "research") they disagreed.

A logistic regression model, with positivity as the response variable (defined as "Strongly Agree" or "Agree") and indicator variables for group and survey item, was used to assess the significance of these visual differences. After adjusting for survey item, it was found that Scholars responses were significantly more positive than other S-STEM eligible students (p-value = 0.0003) and other FY STEM students (p-value < 0.0001). Given that access to the intervention (participation in the LAS Scholars Program) was not determined at random (Scholars were selected for their perceived enthusiasm for STEM fields), these findings cannot conclusively be attributed to participation in the program. However, there is a strong association between participation in the program and a sense of belonging and scientific identity.

External Program Evaluation

NSF S-STEM projects are required to have "clear and specific plans for assessment and evaluation," to be conducted by an evaluator that is external to the project (NSF, 2012). The external evaluator for the LAS Scholars program administered the same survey to each cohort at the beginning and end of their first year, and conducted focus groups at the beginning and end of each cohort's first year to provide additional context and formative and summative feedback.

The beginning and end of year surveys included a number of "knowledge" and "comfort" questions to which respondents were asked to rate their agreement. Both cohorts of Scholars saw knowledge growth from the beginning to end of the year in several areas. For example, by the end of their first year, all Scholars agreed or strongly agreed that they were more knowledgeable about the wide array of STEM fields and more interested in them, more prepared to read scientific literature and undertake research in their science or math field, and more aware of the interdisciplinary nature of many scientific undertakings as well as the diversity of scientists in science and math. All Scholars also said they better understood the scientific process, the role of inductive reasoning in the scientific process, and how to use inductive reasoning. Perhaps the largest growth area for each cohort was agreement with comfort presenting at a conference; the percentage of Scholars in agreement increased from 62% to 92% by the end of the year in the first cohort and increased from 43% to 100% by the end of the year for the second cohort.

Focus group meetings provide additional information about specific aspects of the program that Scholars found helpful. Both cohorts agreed that the warm welcome to campus by the LAS Scholars faculty team made the transition to college less intimidating. They also indicated that the program orientation helped them to acclimate to the campus and the program. Many students noted the accessibility of the program's faculty members made them feel supported. Most students agreed that the program's first year courses were valuable for the exposure they provided to science and math fields, faculty, and skills. Many indicated that it was helpful to take these courses with their cohort. Additional feedback about the program's first year courses is available in the program's submission in the 2018 STEM for All Video Showcase (Chapman, Chiarenzelli, Hill, Nagel-Myers, and Ramler, 2018).

Focus groups also found that the peer mentoring experience was uneven for the Scholars. Some Scholars found it helpful to meet with an upper-level student in their field, while others indicated that they rarely met with their peer mentor outside of the initial introduction. Many Scholars found their peer mentor helpful around course registration time. Several Scholars indicated that the peer mentors were unnecessary, given the access they had to their faculty mentors and the faculty mentors' commitment to the Scholars.

Secondary Findings from the Cohorts' First Years

Other available data, while it does not speak directly to the success of the program's interventions, demonstrates the success of, and the potential for future success for, Scholars in the program. Such data includes academic performance in the first year and major declaration.

Academic Performance

Figure 2 uses violin plots (Hintze & Nelson 1998) to compare semester grade point averages (GPAs) for each cohort of LAS Scholars and their respective peer groups. Violin plots are a variation of box plots where wider sections correspond to values that occur frequently and narrow sections indicate values that do not occur as often. In both semesters of their first year, the distribution of GPAs for each cohort had a shorter left (lower) tail than all other comparison groups, indicating that no Scholars

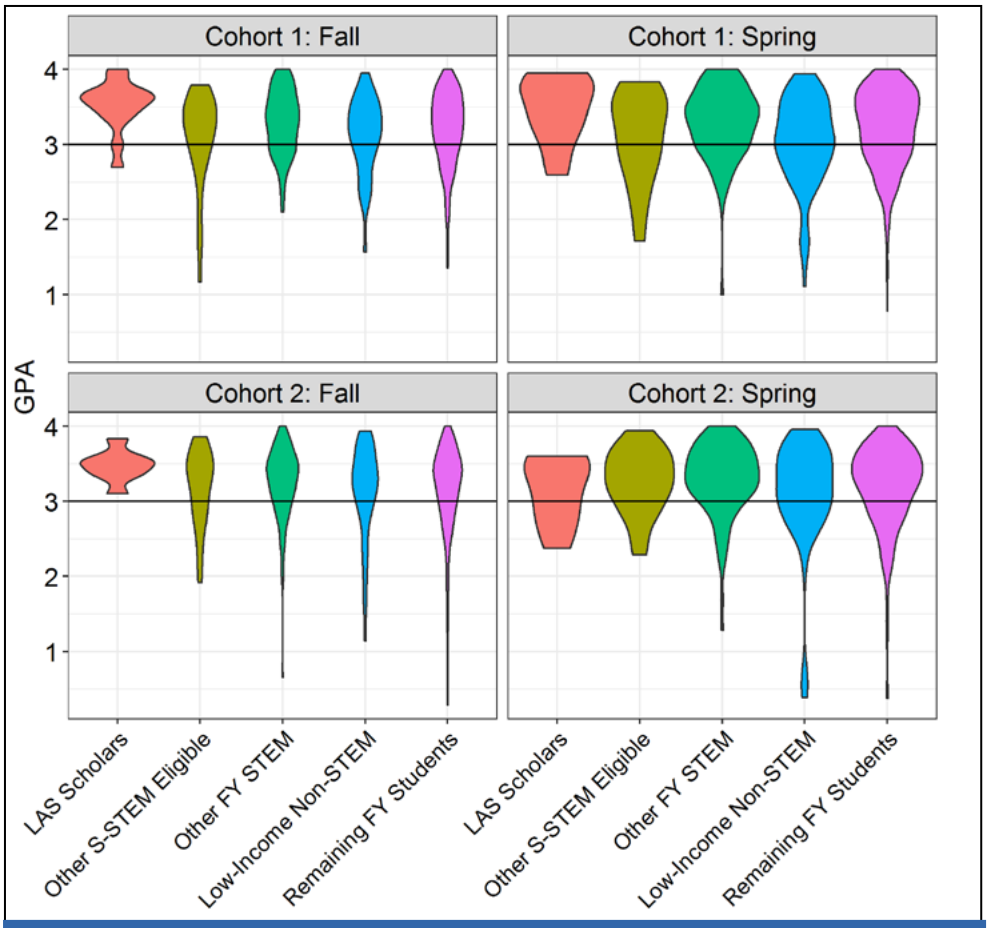

Figure 2: Violin plots comparing semester grade point averages (GPAs) for both cohorts of LAS Scholars to relevant peer groups from the same year. Comparison groups consist of the rest of the corresponding first year class partitioned into four groups: 1) S-STEM eligible (low-income) students who are not in the program, 2) all other first year students interested in science and math, 3) low-income students not interested in science and math, and 4) the remainder of the corresponding first year class. A horizontal line indicates a GPA of 3.0, for reference.

had an especially poor academic performance. Further, in each semester (for each cohort) a relatively small fraction of Scholars fall below the threshold of a 3.0 semester GPA.

Because of the common structure of the first year at St. Lawrence in general, and the LAS Scholars program in particular, we combine the two years together to further analyze the data. Separate logistic regression models, with being at or above the 3.0 GPA threshold as the response variable and indicator variables for peer group as predictors, were fit for the fall and spring semesters. Separate models were deemed appropriate because in the fall semester all students were likely taking courses that aligned with their classified interest (either on a science or mathematics path, or not), but for the spring semester, with the exception of the LAS Scholars, it is unknown whether or not the students in each peer group were taking courses that correspond to their classified interest. In the fall semester model, the LAS Scholars were significantly less likely to have semester GPAs below 3.0 than all of the peer groups (Other S-STEM Eligible, p-value=0.0153; Other FY STEM, p-value=0.0289; Low-Income Non-STEM, p-value=0.0163; Remaining FY Students, p-value=0.0166). In the spring semester, there were no significant differences in the likelihood of being above/below the 3.0 semester GPA threshold between the LAS Scholars and other peer groups (all p-values were larger than 0.1). However, it is important to reiterate that it is known that all LAS Scholars were pursuing a track in science or mathematics in the spring semester, but it is unknown if students in any of the other peer groups continued to follow a path that corresponds to their group classification. Further, it is also important to reiterate that participation in the LAS Scholars Program was not determined at random, and thus any significant differences cannot conclusively be attributed to participation in the program.

Major Declaration

While major declaration at SLU occurs in the sophomore year, it is heavily influenced by experiences in the first year and is thus discussed here. Table 1 summarizes major declaration for the Scholars by underrepresented group (first generation college student, student of color, female). Every Scholar belongs to at least one group traditionally underrepresented in STEM. The most popular majors among Scholars are Biology (6), Chemistry (4), Mathematics (3), and Statistics (3), but every science and mathematics field represented at SLU gained at least one major from the program. SLU also has a special program in which students can pair their liberal arts education with an engineering degree. This is typically done by spending three years at SLU and then two years at a partner engineering school, with students earning a bachelor's degree from both institutions. At least one Scholar (Chemistry) is on track to complete this program.

While some Scholars declared a major that matched their interest at the time of their matriculation at SLU, many experienced at least a slight shift in their interests. For example, several Scholars expressed an interest in Biochemistry upon entry into the program, but based on their first year experiences decided to major in either Biology or Chemistry. Other Scholars had more significant changes in their interests, for example Biology to Geology or Computer Science and Chemistry to Statistics. Also noteworthy is the fact that no Scholars entered the program intending to major in either Geology, Computer Science, or Statistics, but each field gained at least one major from the program. We believe the broad science and math exposure students received in their first year allowed them to find the science and math field that best aligned with their interests. Additionally, several Scholars have paired their science or math major with a second non-STEM major or minor. Second non-STEM majors include Art-Art History, Econom-

First Generation College Students	Students of Color	Females
Biology (3)	Biology (2)	Biochemistry (1)
Chemistry (4)	Chemistry (1)	Biology (6)
Geology (1)	Neuroscience (1)	Chemistry (2)
Mathematics (2)	Statistics (3)	Computer Science (1)
Statistics (1)		Conservation Biology (1)
		Mathematics (3)
		Neuroscience (1)
		Physics (1)
		Statistics (3)

Table 1: Summary of major declaration by underrepresented group. All Scholars belong to at least one of these groups. Some Scholars have declared more than one science and math major and are double counted in the table.

ics, Multi-languages, and Psychology, while non-STEM minors include Education, Gender and Sexuality Studies, Psychology, and Sports Studies and Exercise Science.

Conclusion and Discussion

All of the metrics considered suggest the LAS Scholars model has the potential for improving the retention and academic success of low-income students in the natural, physical, and mathematical sciences. The program's first year retention was comparable to the overall first year retention rate at St. Lawrence University. Institutional survey data (using a validated national survey instrument) suggests that LAS Scholars experience a higher sense of belonging to a scientific community and that they are more likely to identify as scientists than relevant science and math peer groups at SLU. Those findings are corroborated by qualitative findings from focus groups conducted by the project's external evaluator and anecdotal evidence seen with some Scholars still living with someone from their cohort. The typical academic performance of both cohorts was at least as good in both semesters of their first year as relevant peer groups, with Scholars being significantly less likely to have experienced "poor" performance (semester GPA below 3.0) in their first semester than any of the other peer groups. We believe that this is related to the program's requirement of a 3.0 cumulative grade point average; if the program's faculty mentors identified a student that was struggling, they quickly intervened to provide individual attention and advising, which helped prevent the "worst case scenarios."

Focus groups conducted by the program's external evaluator did find that Scholars had inconsistent experiences with the program's peer mentoring component. Differences in experiences could be explained, in part, by the mentoring style and commitment of the peer mentors (Leidenfrost, Strassnig, Schabmann, Spiel, & Carbon, 2011). More extensive training and methods to ensure accountability would be necessary to ensure consistency of the peer mentoring experience (Budge, 2006). It is also possible that Scholars found other avenues of peer support outside of the program's peer mentoring component. For instance, most Scholars were enrolled in a "peer workshop" as part of their introductory science courses, which allowed them to meet weekly with a peer workshop leader and other peers in their field.

Given the available evidence, it is likely that much of the cohesiveness and sense of community seen amongst the LAS Scholars was fostered by the program's orientation, cohort classes, and faculty mentoring component. All of these supports were aimed at combatting three of the main barriers to STEM persistence: capacity, interest, and belonging. The orientation and first year cohort classes, for example, were designed to simultaneously emphasize basic skills/ideas common to all STEM fields and their relevance to broader, real world problems. Packard (2016) notes the importance of this approach by saying ". . . saving the challenges and excitement for later in the major means losing the interest of many students and the opportunity to ignite that interest in others" (p. 16). Further, none of the supports were specific to any discipline or type of institution. Additionally, the multidisciplinary approach taken by the program facilitates success (towards NSF S-STEM objectives) by allowing students to shift among science and mathematics fields as their exposure to the variety in these fields increases, as naturally tends to happen with young undergraduate students.

Our early findings are promising, and the project team will continue to collect data (e.g., major declaration, academic performance, retention, attitudinal data, and post-college outcomes) as the Scholars progress through their years at St. Lawrence to determine if the LAS Scholars program truly succeeds at its goals of improving the support of low-income students interested in science and math and increasing the number of students who pursue STEM careers.

Disclaimer

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