A Rolling Stone: Evaluation of one NSF S-STEM Program through Successive Grant Periods

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Abstract

In 2008, Gannon University was awarded a National Science Foundation S-STEM grant, which provided scholarship funding for academically talented students in STEM fields, having financial need. The program developed at Gannon University was designed to be quite extensive, providing an educational experience emphasizing not only technical mastery, but personal and professional development and community service through partnerships with nonprofit organizations in the local community. At the time of its development, the program was one-of-a-kind, providing a unique tool to marry technical education with the community-service mission of the university. The development of the program and lessons learned through the four years of that grant activity were previously detailed in another publication. Since that first grant was implemented, two more such grants have been awarded which have allowed the program at Gannon University to continue and evolve. The second four-year grant award period has been completed, and the most recent grant activity is in the midst of its first year. In the current paper, the authors describe lessons taken from the first grant activity, responsive changes made in the second grant activity, further lessons taken from that second grant and proposed responses to be incorporated in the current iteration of the grant. Topics of this paper include actions taken to foster better gender diversity in the program, evolution of grant-activity goals as a response to fruitless efforts, lessons learned with respect to identifying external partners, and lessons taken about assessment of student progress (along with warning signs of imminent trouble) along with planned actions to improve student success outcomes.

Section I: Overview of Gannon University Demographics in Engineering

Gannon University is a private, primarily undergraduate institution (PUI) offering associate's, bachelor's, master's, and doctoral degrees and certificates, with approximately 4,350 students (3100 undergraduate). The Carnegie Foundation classifies Gannon University as a PUI in the Masters L level category. For full-time faculty, the percentage of female faculty members is 36.71% in Science, Technology, Engineering, and Mathematics (STEM) departments and 54.73% in non-STEM departments. The academic programs are organized into three colleges: the College of Humanities, Education and Social Sciences; the College of Health Professions and Sciences; and the College of Engineering and Business. The NSF S-STEM activity described herein offers scholarships only to students within the identified engineering and computer and information science majors of the College of Engineering and Business.

Table 1 includes baseline data for women and minority STEM students at Gannon University through the 2014-15 academic year, the last year prior to start of the current NSF S-STEM grant. Table 2 presents the University retention data for STEM students during the period of this analysis. Data for these tables was obtained from the Office of Institutional Research and Assessment of Gannon University.

TABLE 1: UNIVERSITY / STEM DEMOGRAPHICS

	2012-2013	2013-2014	2014-15
University FT undergrad enrollment	2525	2556	2593
Engineering & Computer Science (FT counts)	217	264	325
University Minority Representation	10.37%	10.29%	10.92%
STEM Minority Representation *	12.25%	13.80%	13.15%
University Gender Mix	58% Female	57% Female	57% Female
Engineering & Computer Science Gender Mix	13% Female	11% Female	12% Female

* Note that most of the minority undergraduate population in STEM consists of students who are ineligible for SEECS due to NSF citizenship/residency requirements

TABLE 2: UNIVERSITY RETENTION DATA FOR STEM STUDENTS

Retention	% Continued to 2nd year	% Continued to 3rd year	% Graduated in 4 years
Retention-All Students*	82.10%	71.60%	49.70%
Retention within STEM Majors*	71.64%	58.20%	42.40%

*Cohort Year 2008 (2008-2012)

Section II: Overview of the SEECS program

The "Scholars of Excellence in Engineering and Computer Sciences" (SEECS) program was established in 2008 at Gannon University, funded by the National Science Foundation (NSF) Scholarships in Sciences, Technology, Engineering and Mathematics (S-STEM) program [1]. Initially funded for four years of scholarship granting (plus an additional, unfunded planning year) it has since been funded twice more (NSF Grant numbers 1153250, 1643869), and is now in its ninth year of scholarship granting activity. The first two grant periods, herein known as SEECS 1 and SEECS 2, were each funded for $600K over the life of the grant; SEECS 3 (the current grant) is funded for just a few dollars short of $1M.

SEECS incorporates a mandatory zero-credit seminar course known as the Professional and Personal Development Seminar that all students must take and pass each semester for which scholarship funding is received. Seminar activities include invited lectures on technical topics and technical tours; presentations and activities designed to provide preparatory experiences as students transition from college to work or cooperative education/internship; activities to help students better understand their own personal needs for career success (such as what each student might need to best ensure his or her own spiritual, social, physical wellbeing); and a design component where student cohorts are tasked with creation of a solution to a real-world problem

experienced by a local non-profit organization. The seminar meets once per week, with some additional out-of-class activities, devoting approximately half of all class time to design, and the rest split among professional and personal development activities. Out-of-class activities include the tours mentioned, invited lectures and purely social activities. To-date, SEECS has granted 217 student-years of scholarship funding and has seen 40 students graduate from the program. Current SEECS enrollment is 25 students.

Section III: Evolving Goals and Objectives through three S-STEM Awards

In addition to formative evaluations of the SEECS activities, data elements and metrics were employed to assess the goals and objectives of the SEECS 1 (2009-2012) and SEECS 2 (2013-2017) awards. Tables 3 and 4 present the evolution of the goals and objectives throughout the awards. Table 5 highlights selected data points and metrics that have been used to assess the program objectives.

TABLE 3: SEECS GOALS EVOLUTION THROUGH THREE NSF S-STEM AWARDS

Goal	SEECS 1	SEECS 2	SEECS 3
G1	Increase the number of academically talented, financially disadvantaged students enrolled in Gannon University's computer science and engineering programs, **especially minority, female, and disabled students**	Increase the number of academically talented, financially disadvantaged students enrolled in Gannon University's engineering and computer science programs, especially **women and underrepresented minorities**	Increase the number of low-income, academically talented students with demonstrated financial need, **especially women**, enrolled in and graduating from Gannon University's engineering and computer science programs
G2	Assist students to continue their STEM education through graduation using a program of scholarships and rigorous academic support,		
G3	Foster professional development to prepare students for careers in STEM fields and graduate education		
G4			Study the impact of targeted interventions on retention of high academic performing students, focusing on attrition-point courses

TABLE 4: SEECS OBJECTIVES EVOLUTION THROUGH THREE NSF S-STEM AWARDS

Obj.	SEECS 1	SEECS 2	SEECS 3
O1	Provide **20** scholarships per year for academically talented, financially disadvantaged STEM majors, especially those from underrepresented groups		Provide **25** scholarships per year for low-income, academically talented, Engineering and Computer Science majors, especially **women**, with demonstrated financial need
O2	Build a referral network arrangement between Gannon University, the Erie City School District and the local U.S. Dept. of Education Talent Search program to identify and recruit financially disadvantaged students from underrepresented groups who meet SEECS scholarship eligibility requirements		
O3	Provide a program of academic and student service support that achieves a **90% year-to-year retention** rate for SEECS scholars		Provide a program of academic and student service support that

			achieves an **average 80% freshman to sophomore retention rate** in STEM majors for students brought in as SEECS scholars
O4	Provide scholars with academic and professional development that prepares them for employment in a STEM field and/or graduate school		
O5		Implement recruitment strategies to increase and maintain the number of **women and underrepresented minorities at a minimum of 20%** of the SEECS scholars	Continue successful recruitment strategies and develop enhanced recruitment strategies to **achieve a 24% rate of women** applicants

SEECS 1

Goals and Objectives Assessment

At the end of SEECS 1 (funded fall 2009 – spring 2013) the data supported the processes and activities developed and implemented to recruit students to the program, which has been a barrier in some S-STEM programs [2]: 20-26 scholars per year were engaged in the program while the average award was adjusted based on need and number of participants per year. It is evident by the data (refer to Table 5) that the recruitment of minorities, female and disabled participants was not achieved during this grant. The initial pool of applications with these characteristics was very low which is consistent with the overall demographics at the institution (refer to Table 1). As retention was examined, the year-to-year retention in the SEECS program was on average 84.8% (5.2% below the objective), though still markedly better than university retention as a whole. Plans were develop to improve the outcomes associated with these two objectives.

Changes identified at the end of SEECS 1

1. *Develop targeted materials to enhance the recruitment of women and underrepresented minorities*. In order to better attract women and underrepresented minorities, new strategies were developed drawing upon best practices identified by other NSF-funded projects [2]. A mailing postcard campaign was developed and implemented in 2013 (Figures 1 and 2). For example, for the 2014 freshmen cohort 4,161 postcards were mailed to the targeted groups in three different mailings throughout the year (April 2013, October 2013 and February 2014). This campaign has evolved to include e-blasts since 2014 employing both admissions and the marketing department.

2. *Enhance the activities and supports to achieve 90% retention*. The goal to achieve 90% retention involved looking at the support services, intrusive advising and capitalizing upon upperclassmen to support the freshmen during their first year. As part of the program, the PIs become secondary academic advisors for the scholars. The PIs dedicated several meetings to review students' progress during the semester paired with constant communications with those students that were identified as at-risk. Informal tutoring sessions were encouraged and facilitated to connect SEECS upperclassmen with SEECS freshmen. The enhancements to the program and activities achieved the 90% year-to-year retention in SEECS 2. As the retention numbers were examined, it was clear that interventions needed to be specifically targeted to improve freshmen-to-sophomore retention.

TABLE 5. SELECTED DATA ELEMENTS AND METRICS TO ASSESS THE SEECS PROGRAM

	SEECS 1				SEECS 2			
	Year 1 (2009-2010)	Year 2 (2010-2011)	Year 3 (2011-2012)	Year 4 (2012-2013)	Year 1 (2013-2014)	Year 2 (2014-2015)	Year 3 (2015-2016)	Year 4 (2016-2017)
				Objective 1				
Number of eligible freshmen	25	20	38	43	84	94	102	139
Number of applications for freshmen cohort received	17	17	15	18	28	30	24	17
Non-Caucasian applications	6% (1/17)	6% (1/17)	7% (1/15)	0% (0/18)	0% (0/28)	3% (1/30)	0% (0/24)	12% (2/17)
% female applicants	6% (1/17)	6% (1/17)	13% (2/15)	11% (2/18)	10.70% (3/28)	30% (9/30)	39% (7/24)	24% (4/17)
Number of accepted awards, freshmen cohort	8	6	10	9	8	9	9	9
Number of accepted awards, all cohorts	20	22	23	26	26	25	25	25
Average award	$6,028.70	$6,119.82	$4,945.04	$5,165.84	$4,754.00	$4,441.28	$4,638.00	$7,633.48
							Objective 5	
Non-Caucasian, across all cohorts	0% (0/20)	0% (0/22)	4% (1/23)	4% (1/26)	4% (1/26)	4% (1/25)	0% (0/25)	0% (0/25)
% female, across all cohorts	5% (1/20)	9% (2/22)	13% (3/23)	11.50% (3/26)	19.23% (5/26)	36.00% (9/25)	20.00% (5/25)	28.00% (7/25)
				Objective 3				
Year-to-year retention in program	16/20 (80%)	21/22 (95.5%)	19/23 (83%)	21/26 (80.8%)	22/25 (88%)	24/25 (96%)	24/25 (96%)	23/25 (92%)
Year-to-year retention freshman	6/8 (75%)	5/6 (83%)	7/10 (70%)	7/9 (78%)	7/8 (88%)	8/9 (89%)	7/7 (100%)	7/9 (78%)
Year-to-year retention upperclassmen	10/12 (83%)	16/16 (100%)	12/13 (92%)	14/17 (82%)	15/17 (88%)	16/16 (100%)	17/18 (94%)	16/16 (100%)
Overall year-to-year retention in STEM	17/20 (85%)	95.50%	87%	22/26 (84.6%)	24/25 (96%)	25/25 (100%)	25/25 (100%)	24/25 (96%)
				Objective 4				
Graduates from the SEECS Program	3	6	4	5	4	5	6	6
Graduates reporting employment in STEM field or continuing education	2	5	3	5	4	5	5	6
Graduates with unknown status	1	1	1	0	0	0	1	0

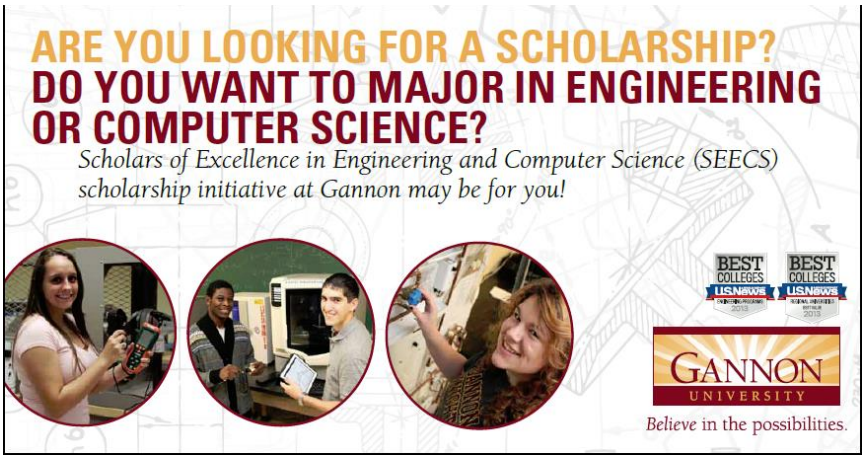

FIGURE 1. 2013 POSTCARD TARGETING WOMEN AND UNDERREPRESENTED MINORITIES

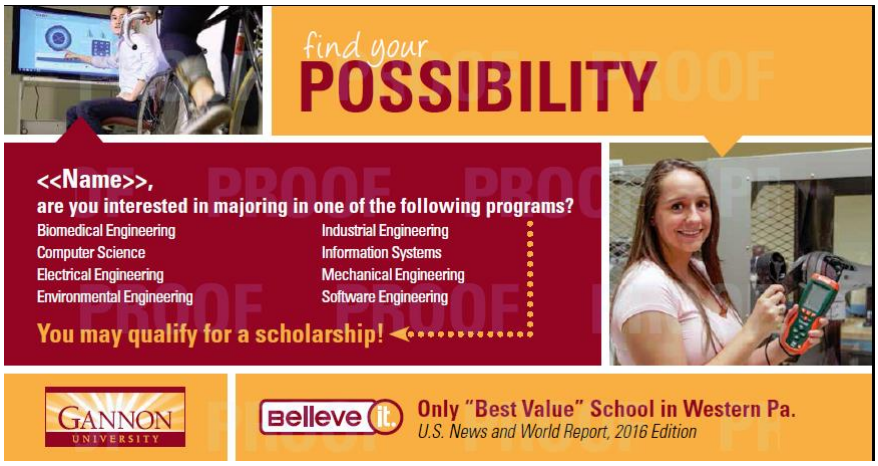

FIGURE 2. 2015 PERSONALIZED POSTCARD TEMPLATE TARGETING WOMEN AND UNDERREPRESENTED MINORITIES

SEECS 2

Many of the lessons learned from SEECS 1 were implemented in SEECS 2. However, some activities in SEECS 1 were not achieving the expected outcomes; therefore, these activities were adjusted and continued in the second award. As SEECS 2 implementation continued, it became clear that two efforts were not providing the desired outcomes.

Changes identified through and at the end of SEECS 2

1. *Recruitment efforts to focus on female scholars.* The effort to recruit female scholars through the SEECS 2 award produced the desired results: the percentage of female application increased from 11% to 39% in two years; the overall gender mix across all cohorts achieved the objective of 20% female during the four years of SEECS 2. On the other hand, the program was having limited success in finding underrepresented minorities to apply to the program and was unsuccessful in convincing any of the accepted applicants to actually deposit and enroll. Based on this, during SEECS 2 the focus was shifted to recruiting female scholars and the SEECS 3 grant removed the language from the goal addressing underrepresented minorities (refer to Table 3). In essence, this change was seen as a forced acceptance of inherent limitations based upon the general historic nature of the student body at Gannon University. This may be reconsidered if campus-wide demographics change to suggest higher probability of success in minority-recruitment efforts.

2. *Eliminate efforts to build a referral network with the Local U.S. Dept. of Education Talent Search program.* Although the SEECS program has included scholars who attended High School in the Erie School District, these scholars did not participate in the Talent Search program. Since the school district allows students to participate in only one external program (such as Talent Search, Upward Bound, and GOCollege), working closely with only Talent Search puts the main focus of recruitment on a very small pool of potential SEECS applicants. In addition, Gannon University was already running the GOCollege program so there was a natural linkage between SEECS and GoCollege.

Further, most of the high school students in the district who meet SEECS eligibility criteria attend one particular high school. All SEECS scholars who graduated from the Erie School District attended that particular high school. This school has very limited participation in the above-mentioned external programs. These students were referred to Gannon and the SEECS program by their guidance counselors and not by Talent Search, Upward Bound or GOCollege. Based on this, the language of networking with a specific local program was seen as unnecessary and removed from the SEECS 3 grant objectives

New Initiative: Formal targeted intervention to improve freshmen-to-sophomore retention

Throughout the life of the SEECS activities, some scholars have left the program, for a variety of reasons. One scholar left the University to attend a school closer to home. A few switched their major to one that no longer qualified to receive SEECS funding. Others no longer qualified due to low GPA or due to a change in financial need.

In this last group, there were several scholars who appreciated and valued the program and wanted to continue with the SEECS activities, even though they were no longer eligible to receive funding. During SEECS 2, the co-PIs began studying the non-funded SEECS student group. Research interests include intrinsic motivators [3], [4] (The central question is "why do these students wish to continue, without financial incentive?") and barriers to maintenance of GPA requirements [5], [6].

An additional pilot retention program was initiated toward the end of the SEECS 2 grant which utilized a new support program instituted at the University, known as STEM-PASS. These retention efforts were formalized in the SEECS 3 grant after an intensive study that evaluated grades obtained in critical path courses was completed [7], [8]. The retention objective was modified to achieve an 80% freshmen-to-sophomore (the university retention in STEM majors from freshmen-to-sophomore was 72%, refer to Table 2). Details of this effort are discussed in Section V.

Section IV: Evolution of Community Outreach to meet grant goals and objectives

Emphasizing the service-learning aspect of the seminar, the design projects benefit regional non-profit organizations. Design projects are selected in accordance with the mission of Gannon University, which implicitly includes service to the local community. An engineering need of a non-profit community partner is identified, becoming the design project for the next two to three years for each new freshman class. The students become engaged in a long-term relationship with the non-profit community partner. The project provides a platform for exercising technical engineering skills and practices. The design activities pair the freshmen cohort with the seniors; the sophomores with the juniors. Through these pairings, the students learn from each other while working on a real-world problem. Hence, the learning becomes relevant and the scholars excel as they share the intellectual, problem-solving aspects of design for an organization valuing their contribution. Further details of this service aspect of the program can be found in [9].

As of the beginning of SEECS 3, nine design projects have been fostered: six have been fully implemented, one is in the deploy phase, one is in the design and implementation phase, the most recent project is in requirements gathering stage. Each project has complemented different distributions of majors and required different technical competencies. Although structurally

different, all nine projects incorporate the aims of the SEECS program. Tables 6 and 7 summarize the projects and disciplinary content of the nine design projects.

TABLE 6: SUMMARY OF SEECS COMMUNITY SERVICE PROJECTS WITH ORGANIZATIONS AND PROJECT STATUS

Project title	**Organization (Stakeholder)**	**Project duration**	**Status**
Redesign boat ramp	Bayfront Maritime Center	2009-2010 Sophomore-Junior project	Completed
Go green bicycle-powered electrical generator	Gannon University	2009-2011 project	Completed
Cascade creek flow diagnosis	Sea Grant Pennsylvania	2010-2012 project	Completed
Kit assembly assist	Barber National Institute	2011-2013 project	Completed
Improving Airflow in a 3-Bedroom House Design	Habitat for Humanity	2012-2014	Completed
CHOSEN steam generator	Christian Hospitals Overseas Secure Equipment Needs (CHOSEN) Mission Project	2013-2015 project	Completed
CHOSEN medical sterilizer	CHOSEN	2014-2016 project	Completed
Uniform display case	the Pennsylvania Soldiers and Sailors Home	2015-2017 project	Deploying
Renewable power station	Gannon University	2016-2018 project	Design and implementation
Green Gym	Gannon University	2017-2019 project	Requirement gathering

It can be noticed from Tables 6 and 7 that throughout the years, projects have varied widely. At the beginning of SEECS 1, the faculty members contacted local non-profit companies, gathered potential project ideas, and presented these ideas to SEECS students. Students selected the project, to be completed as a single group. Once the project had been selected, it was left to the students to communicate with stakeholders through the development phase of the project. Since the students were freshmen, they tended to take on projects that were idealistically more interesting, but which had unrealistically broad scope. As a result they were often unable to complete the project on time. This problem was complicated by Stakeholders' changes in specifications as time passed, and also by personnel changes within the client organization. The response to this spectrum of problems was to have SEECS faculty members choose the projects and work to alleviate specification creep.

Another evolutionary change in the design selection process came in the form of collaboration with the university's Office of Service-Learning (OSL), which helped the SEECS faculty members to identify projects that (a) were of local interest, (b) served non-profit entities, (c) aligned well with the university mission, and (d) had university-identified stakeholders. The use

of the OSL also helped expand the set of university resources available to SEECS students. Our experience has shown that working on a project identified first by the OSL opened up financial resources from the OSL for project completion. OSL also provided a handy liaison to other university departments and offices.

The duration of the projects has informally evolved from 2-years to 3-years. (Per wording of the SEECS 3 grant application, the project is still expected to be completed in two years.) In projects carried out using the two-year model, freshman students gathered information and came to understand the requirements, but by the end of the first year as a general rule, they were not emotionally attached to the project yet. In the sophomore year, the students generated concepts and began to get excited, but tended to run out of time for the full implementation by the end of the year. Experience showed that in the junior year, the students were truly engaged in building, testing, and grooming the device prior to delivery. The third-year run over was thus seen to be beneficial, overall, to student satisfaction with the design experience. Additionally, students are expected to attend a regional conference in their junior year to present their design. Continuing the project into the third year is supportive of this presentation requirement. Evidence has shown that dragging the project to the senior year works poorly because the students get bored, or become easily distracted with other pressing problems related to impending graduation. It is also counterproductive because we rely on senior students to provide mentoring to freshmen. Time spent on finishing their own design is time unavailable for mentoring.

TABLE 7: CORRELATION BETWEEN SELECTED PROJECTS AND ENGINEERING AND COMPUTER SCIENCE MAJORS

	BME	**CIS**	**ECE**	**ENV**	**IS**	**ME**	**IE ***	**SE**
Redesign boat ramp				√		√		
Go green bicycle-powered electrical generator			√			√		
Cascade creek flow diagnosis				√		√		
Kit assembly assist	√	√	√		√	√		√
Improving Airflow in a 3-Bedroom House Design								
CHOSEN steam generator		√	√		√	√		√
CHOSEN medical sterilizer	√	√	√		√	√		√
Uniform display case		√	√		√	√		
Renewable power station			√			√		
Green Gym			√			√		

* Note that IE is a new major at Gannon University, and thus IE students have only recently been included in the SEECS student mix; projects related to IE have not previously been sought.

Section V: Warning Signs and Activities to improve student success outcomes

SEECS students may be removed from the program for any of three reasons: change of major to ineligible major, loss of financial need (in which case, students are allowed to continue to participate if they wish, but lose scholarship eligibility – another change implemented between SEECS 1 and SEECS 2) or low GPA (meaning, cumulative GPA falls and remains below 3.0).

Two "warning signs" have been noted which relate to student retention in the SEECS program. These warning signs relate to academic performance in key courses and to lack of social support.

The first "warning sign" of imminent danger has been discussed in a previous paper, [6] wherein an analysis was provided which showed that, among SEECS students, there was a strong apparent correlation between "low" grades (defined as "lower than B") in certain core courses and eventual loss of eligibility due to low GPA. Only a small number of courses is common to all SEECS students (Calculus I and II) though the majority also take a basic Calculus-based physics course. These courses taken at the university were seen to be "problem children," so to speak, confirming the findings of [10], [11]. It was demonstrated that 50% of all students who received less than a "B" in either the first Physics or the first Calculus course taken at this university (allowing for AP credits and/or transfer equivalency) eventually were dismissed from SEECS due to low GPA; 100% of students who got "C+" or lower grades in both of those courses were eventually dismissed from SEECS based on GPA. (Note: "B- "grades did not exist at Gannon University at the time of the initial finding of this correlation. Thus "lower than 'B' implies "C+" or lower. "B-"grades have not yet been definitively assessed.)

Working on the assumption that eventual loss of GPA is a result of lack of fundamental understanding of the material of these first Physics and Calculus courses, SEECS has worked to implement an intrusive advising strategy, along with mandated enrollment into particular sections of Physics and Calculus courses for all SEECS students. [7], [8].

STEM-PASS is a rather new initiative at Gannon University, wherein extensive tutoring is provided to students enrolled in designated class sections. Paid upper-class students who have previously mastered the course are tasked with sitting in on the lectures, taking notes about the material and professor priorities, and providing one-on-one or small-group tutoring to students registered in the course. The student is paid for 10 hours per week, nominally on a work-study basis, and provides tutoring during prearranged hours. It is up to the course instructor to determine how "mandatory" it is for students to make use of this tutoring. Student tutors are tasked with recording hours spent in STEM-PASS tutoring sessions by each student registered in the course. Instructors collect this data, and it is used in a statistical analysis of grade achieved in the course as opposed to grade that might be expected for each student, and correlated with STEM-PASS hours put in by the student. The central question is that of the SEECS research focus: is there a measureable effect of intensive academic tutoring on student academic performance of nominally high-performing students? A subsidiary question (assuming the answer to the first is positive) is "what might be an optimal level of intervention for these high-performing students?"

Beginning in fall 2017, all incoming SEECS freshman students who are to be enrolled in Calculus I are automatically enrolled in sections designated as "STEM-PASS" sections. Continuing forward, SEECS students are directed into STEM-PASS sections of Calculus II and Physics I. Exceptions are made only on the basis of schedule incompatibility. So far, the general data on effectiveness of STEM-PASS for the general student population shows good promise for students entering the semester in the middle of the GPA range. The specific effectiveness for high-performing students, however, needs still to be teased out.

For purposes of analysis, we define "high performing" as "having a GPA of at least 3.0 upon entering the semester." SEECS students in good academic standing fall into this category, but

they form a very small pool, and a smaller pool yet when only students in Calculus I, Calculus II or Physics I are considered. As a response to the implicit problem of statistical validity, SEECS faculty members are looking at all students who otherwise fall into the high performing group, regardless of SEECS status. Historic data is available to correlate eventual grade in the course to GPA upon course entry. Data from STEM-PASS sections will be examined side-by-side with the historic data and with contemporary grade data for high performing students in non-STEM-PASS sections. The total number of STEM-PASS hours recorded for each student during the semester will also be considered. Comparisons will be made to assess general efficacy of STEM-PASS for high performing students. Data sufficient to prove or disprove effectiveness may take more than one academic year to gather, however, due to small pool size and normal variations in student performance from year to year.

Further to the study of general effectiveness of STEM-PASS, SEECS faculty members will also be looking to see whether the loss rates due to low GPA continue the trend shown in [6].

As an additional action to improve academic performance of SEECS students, the SEECS faculty members have tasked senior SEECS students with on-request, informal tutoring of other SEECS students. For example, a SEECS sophomore mechanical engineering major struggling in Dynamics is encouraged to approach a SEECS senior mechanical engineering or environmental engineering student for help. The seniors are made aware of their critical mentoring role (which applies also to the design aspect of the SEECS program) and the value of this service both academically and as a community-building activity. Seniors are not paid for this service; it is provided voluntarily and in accordance with student availability. So far, this request has not met any resistance from seniors – they have thus far embraced the role whole-heartedly.

The second "warning sign" is more difficult to quantitatively define, but is anecdotally noticeable. There have been several instances of loss of students from SEECS (sometimes from the university as a whole) due to what appears to be a lack of community connection. It is noted, for example, that students who do not "gel" with other SEECS students of their own cohort do not get the required grades to continue, either. This is a source of discussion only, at this point. Questions are being asked by the SEECS faculty members about whether the lack of connection is due to the infrequent occurrence of purely social activities in the group, whether lack of academic confidence might be causing what might informally be termed "shyness," or "bellicosity," or whether student motivations for entering STEM (specifically, engineering and computer science fields) might be weak.

Attempts to address prospective lack of social activity have fallen somewhat short, to date. SEECS does have normally two to three primarily social events each semester. That level of social activity is thought to be about the maximum that can be demanded of students, given the requirements that must be met in the rest of the seminar activities. In order to bolster that social aspect, each class has previously been tasked with identifying a small number of additional social events to be held outside of class time, and to which all SEECS students are invited. A budget has been provided to pay for the chosen events. Though this has been tried several times, so far only one activity has been chosen by the students, and only a small number of students participated. Thus far, this approach has not shown to be particularly effective. Again, anecdotally, and somewhat surprisingly, students seem to prefer social activities in which faculty members also participate.

To the point of academic lack of confidence, it is hoped that interventions as described above through STEM-PASS and (perhaps more so) through upper-division to lower-division student-to-student mentoring will be helpful in both developing confidence and improving connectedness to the group. It is hoped that, at a minimum, the belligerent behaviors which have led to the dismissal of a small number of students may be relieved by increased sense of community.

Finally to the point of motivation, a study is currently ongoing by the SEECS faculty. Students are being asked particular questions to assess their intrinsic motivating factors. (For example, some are motivated by rewards, some by sense of belonging, etc.). Data collected through self-reported surveys has been taken from SEECS students for several years. Only a small number of SEECS students have been available for analysis since data gathering started. The small pool of students makes collection of a compelling amount of data slow going, but analysis has begun. The results will be the subject of another paper.

Section VI: Conclusions

This paper has described a number of unforeseen obstacles to success that have been encountered in administration of a service-oriented, scholarship-granting seminar activity. Obstacles have been identified with regard to recruitment of students, retention of students, and project identification and completion. Each of these obstacles has resulted in programmatic evolution in response; the responses seem so far to have been largely positive in effect. Some goals and objectives, however, were merely seen to be unrealistic in the context of the environment of Gannon University, and have thus been eliminated.

In addition, sufficient data has been gathered regarding academic performance of scholarship recipients to allow for postulation of intervention techniques that might be fruitful. These intervention techniques include use of previously-underutilized university resources and incorporation of upperclass students as academic mentors to freshman and sophomore students. This last effort builds upon mentoring activities already in place, and seems so far to have contributed to enhanced group identity.

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