The SEECRS Scholar Academy at Whatcom Community College: An S-STEM Scholarship Program

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Abstract

The STEM Excellence through Engagement in Collaboration, Research, and Scholarship (SEECRS) project at Whatcom Community College is a five-year program aiming to support academically talented students with demonstrated financial need in biology, chemistry, geology, computer science, engineering, and physics. This project is funded by an NSF S-STEM (Scholarships in Science, Technology, Engineering, and Mathematics) grant awarded in January 2017. Through an inclusive and long-range effort, the college identified a strong need for financial and comprehensive supports for STEM students. This project will offer financial, academic, and professional support to three two-year cohorts of students. The SEECRS project aims to utilize a STEM-specific guided pathways approach to strengthen recruitment, retention, and matriculation of STEM students at the community college level.

Scholarship recipients will be supported through participation in the SEECRS Scholars Academy, a multi-pronged approach to student support combining elements of community building, faculty mentorship, targeted advising activities, authentic science practice, and social activities. Students are introduced to disciplines of interest through opportunities to engage in course-based undergraduate research experiences (CUREs) in Biology, Chemistry and Engineering courses, funded summer research opportunities, and seminars presented by STEM professionals. Communities of practice will be nurtured through the introduction of cohort building and faculty mentorship. Cohort development starts with a required two-credit course for all scholars that emphasizes STEM identity development, specifically focusing on identifying and coping with the ways non-dominant individuals (racial/ethnic minorities, non-male gender, lower socioeconomic status, first-generation, 2-year community college vs. 4-year institutions) are made to feel as outsiders in STEM. Each SEECRS scholar is paired with a faculty mentor who engages in ongoing mentor training.

The project evaluation will determine the efficacy of the project activities in achieving their intended outcomes. Specifically, we will collect data to answer the research question: To what extent can a guided pathways approach provide a coordinated and supported STEM experience at Whatcom Community College that: (1) increases student success, and (2) positively shifts students' STEM self-identity? The evaluation will employ a quasi-experimental research design, specifically a pretest-posttest design with a matched comparison group.

Our first cohort of 14 students was selected over two application rounds (winter and summer 2017). We awarded ten full scholarships and four half-scholarships based on financial need data. Cohort demographics of note compared to institutional percentages are: females (64% vs. 57%), Hispanic (14% vs. 17%), African American (7% vs. 2%), white (79% vs. 66%), first generation college bound (43% vs. 37%). The cohort is comprised of six students interested in engineering, six in biology, and one each in geology and environmental sciences. With increased communication between the project team, our Financial Aid office, Entry and Advising, high school outreach, and the Title III grant-funded Achieve, Inspire, Motivate (AIM) Program, as

well as a longer advertising time, we anticipate significantly enhancing our applicant pool for the next cohort. The results and lessons learned from our first year of implementation will be presented.

Background

Whatcom Community College (WCC) was founded in 1967 to serve one of the 22 community college districts established by the Community College Act of 1967. Although originally WCC was a college without a campus bringing education into the community, it is now housed on a 72-acre campus in Bellingham, WA. Whatcom county is a primarily rural county with 16% of the county population at or below the poverty line [1]. The county's ethnic makeup is undergoing a transformation with a growing Hispanic population. In tandem, the college's student of color population has more than tripled from 10% in 1996-97 to 34% in 2017-18. Consequently, the college is serving an ever more diverse student population – with 78% from within the county – in meeting state and national employment needs.

Nationally, far too many STEM-intending community college students are leaving STEM programs. Couturier and Cullinane [2] found that 69% of these students dropped out of a STEM pathway and half dropped out of college entirely without a degree. Furthermore, attrition rates are highest for underrepresented and low-income students [3], [4]. On the state level the workforce need for STEM-trained individuals is even more acute; a recent analysis shows that only 26% of Washington's STEM jobs can be filled by an in-state STEM graduate and, with current STEM graduation rates, the state is on track to meet only 27% of its STEM employment needs [5].

Many students, even successful ones, choose not to pursue STEM degrees because the experiences are unsatisfying and the culture feels unwelcoming [6]. Research demonstrates that all students, particularly those underrepresented in STEM courses, benefit greatly from active and authentic learning experiences [7], [8]. In 2017, WCC administered the Community College Survey of Student Engagement [9]. Although WCC students are not more or less likely to withdraw from a class or school due to full-time work needs when compared to state or national averages, they did report below average college contribution to their career development. Interestingly, WCC students appear to be working fewer hours on average than the national reported average (**Table 1**).

The abovementioned statistics paint a picture where the college is serving an increasingly diverse population that is demonstrably more vulnerable when it comes to STEM career persistence while state employment trends appear to indicate an increasing demand for STEM training in our workforce. As a result of this data and trends, we have identified a strong need for financial and comprehensive supports for our STEM students.

Program Design

The *STEM Excellence through Engagement in Collaboration, Research, and Scholarship* (SEECRS) project will provide invaluable financial and academic support over five years to 36 low-income, academically talented scholarship awardees. The guided pathways approach implemented by this program strives to provide a clear "roadmap" to STEM degree attainment [10], [11], [12], [13]. Scholarship recipients will develop degree plans early in their academic trajectory and will meet quarterly with a dedicated STEM academic advisor to monitor and

evaluate their progress towards the Associate in Science Transfer (AS-T) degree. Many WCC STEM students intend to transfer to a nearby regional university, and the two institutions will partner to provide a comprehensive transfer navigation strategy [14] and optional research opportunities [15].

Table 1. Summary of Relevant CCSE Survey Report Data.

		Difference from comparison groups (2017 WCC student mean minus comparison group mean)				
	WCC 2017	**WCC 2010**	**NWCCU colleges**	**WA colleges**	**Small colleges**	**National**
10. About how many hours do you spend in a typical 7-day week doing each of the following? (0 = none, 1 = 1-5, 2 = 6-10, 3 = 11-20, 4 = 21-30, 5 = more than 30)						
b. Working for pay.	2.23	-0.18	-0.37	-0.14	-0.60*	-0.72*
11. How much has your experience at WCC contributed to your knowledge, skills, and personal development in the following areas? (1 = very little, 2 = some, 3 = quite a bit, 4 = very much)						
a. Acquiring job or work-related knowledge and skills.	2.20	-0.16	-0.20	-0.223*	-0.40*	-0.28*
h. Developing career goals.	2.43	-0.06	-0.16	-0.17	-0.33*	-0.27*
i. Gaining information about career opportunities.	2.25	-0.15	-0.16	-0.17	-0.37*	-0.29*
23. How likely is it that the following issues would cause you to withdraw from class or from WCC? (1 = very little, 2 = some, 3 = quite a bit, 4 = very much)						
a. Working full-time.	2.26	0.09	0.01	0.01	0.12	0.07
b. Caring for dependents.	1.81	0.01	-0.06	-0.06	-0.06	-0.06
c. Academically underprepared.	1.60	0.03	-0.08	-0.08	-0.07	-0.11
d. Lack of finances.	2.46	0.07	-0.09	-0.07	0.10	0.06
c. Transfer to a 4-year college or university.	2.59	-0.03	0.20	0.18	0.48*	0.33*

*Denotes a statistically meaningful difference.

The project foundation includes the development of a *STEM Scholars Academy (SSA)*, institutionalized through a STEM success orientation course coupled to a coordinated and deliberate implementation of degree planning, academic success strategies, and options for undergraduate research in a STEM field. These research opportunities include course-based undergraduate research experiences (CUREs) [16] in the chemistry, biology, and engineering

sequences, and optional compensated summer research opportunities. Scholarship recipients will form the SSA membership, providing them a group identity while supporting them in their coursework, research activities, preparation for transfer, and ultimately the workplace.

The SEECRS project was designed to determine the extent to which the coordinated and supported STEM experience of a guided pathways approach increases student success and positively shifts students' STEM self-identity, including confidence and self-perception. The college currently offers programs and services to students that individually contribute to improved student learning, retention, and completion. This program seeks to determine if a coordinated effort of these activities, coupled with new activities such as formalized faculty mentoring and CUREs, will dramatically improve STEM student persistence and science identity. The SEECRS program was designed with five goals each served by a series of objectives. These goals and the subservient objectives are outlined in **Table 2**.

The SEECRS Program was funded by the National Science Foundation (NSF) in early January, 2017. By February, the leadership team crafted the scholarship application and criteria and began collecting applications through the college's internal general scholarship application portal. By April, the leadership team reviewed 30 qualifying applications and made 13 awards (9 full scholarships and 4 half scholarships); one awardee declined the offer. Over the summer the leadership team continued to receive nominations for qualified candidates through various internal college units. A second review of new applications was made in August and two full awards were made and accepted. The first SSA cohort was convened in the fall quarter of 2017 and consisted of 14 members (10 receiving full scholarships and four receiving half-scholarships) representing engineering (six), biology/life sciences (six), and geology/earth sciences (two). This cohort participated in the STEM Success and Orientation course (*vide infra*) in the fall quarter of 2017. In this paper we will present our experience in designing and implementing the first iteration of our STEM Success and Orientation course, a linchpin component of our program. We will also summarize our program assessment methodology and the current assessment results from a focus group study conducted on the SSA at the end of the STEM Success and Orientation course and a survey administered to faculty mentors.

Table 2. Program Goals and Objectives.

Goal 1: Improve students' STEM self-identity through the STEM Scholars Academy and CUREs (course-embedded undergraduate research experiences) opportunities.
• Develop a STEM specific success and orientation course.
• Develop and offer CUREs in chemistry and engineering.
• Deploy SEECRS project social media.
• Offer optional summer research opportunities in conjunction with Western Washington University.
• Offer student support services and programs including quarterly cohort social events, celebrations, study groups, learning center, tutoring, STEM and engineering clubs, and career services.
• Coordinate optional job shadow and brief internships opportunities.
Goal 2: Increase the rate of STEM recruitment and retention, including underrepresented students.
• Create outreach and marketing materials for the SEECRS scholarships.
• Conduct outreach to and recruit high school and WCC students through AIM, Upward Bound, AVID and other programs that support the success of non-traditional and financially needy students.
• Students meet quarterly with their faculty mentor.
• Develop and offer STEM success course and orientation.
Goal 3: Increase the rate of STEM degree completion for WCC students.
• Develop student degree plans early.
• Quarterly meetings with a dedicated STEM transfer academic adviser.
• Deliberate coordination between the STEM adviser and the faculty mentor.
Goal 4: Increase the transfer rate of STEM students to four-year universities.
• Develop, with Western Washington University, and implement a transfer support / navigation strategy.
• Offer a transfer workshop in spring of cohort year 1 and fall of cohort year 2.
Goal 5: Develop an adaptable model for implementing a STEM guided pathways approach at other community colleges.
• Study the effectiveness and impact of implemented strategies.
• Broad dissemination of project findings and best practices.

STEM Success and Orientation Course Development and Implementation

How do we teach STEM Identity?

While the nuances of the development of our cohort course will be summarized below, it is important to begin by noting that the initial course in which SEECRS scholars were placed was

specifically designed to develop STEM identity. This focus on identity development utilized discourse based identity theory to help students envision themselves as belonging in STEM. Discourse based identity envisions individuals as being the product of stories; stories told about them, and stories they tell about themselves [17]. With this theoretical construct guiding the class, the project team designed specific activities designed to help students identify and amplify discourses that were supportive of their belonging in STEM, as well as strategies for identifying and dampening discourses that questioned their ability to persist in STEM disciplines.

Students read articles by Beverly Tatum on identity construction, and discussions in class explicitly address disproportionate STEM participation for women and persons of color [18]. Class discussions acknowledge disparities and found many of the students noting that they "felt like imposters." The class worked to identify larger social norms that questioned the belonging of marginalized populations in STEM, including women, students of color, non-traditionally aged students, students with disabilities, or students from low-income backgrounds. Classroom discussions included students sharing how their K-12 teachers explicitly perpetuated negative stereotypes about who belongs in STEM. Classroom discussions worked to identify identities with negative stereotypes, and to reframe those identities as uniquely positioned to offer insight and diverse thinking into STEM disciplines. In addition to identifying and reframing negatively stereotyped identities, the project team promoted specific coping strategies for students.

The strategies offered to help students cope with the pressure associated with non-specific identities in STEM contexts included identifying harmful discourses, social studying strategies, and seeking out mentors. Attempts to help students identify harmful discourses is summarized in the paragraph above. In an attempt to counter harmful discourses, students read an article discussing how STEM courses are often perceived as harder than non-STEM courses, and that many who drop out of STEM feel pulled away from STEM by higher grades in non-STEM courses [19]. Class discussions noted that it was okay to struggle in STEM courses, and promoted the idea that repeating a class to improve a failing grade was okay. To help students work to develop social studying strategies, the class read a section from Claude Steele's Whistling Vivaldi which summarizes research by Uri Triesman [20]. The research, which investigated the study strategies of racial/ethnic groups in mathematics, illuminates how studying alone can be unproductive for some. Finally, the importance of mentors was conveyed, and the explicit inclusion of mentors into the SEECRS program was explained. Students were encouraged to network with faculty mentors so that experienced faculty could promote supportive discourses that would help build students' STEM identities.

Class structure and assignments supported the strategies advocated through the readings and class discussions. Class started with two-minute listening partnerships in which students debriefed with each other in an attempt to build familiarity. Readings utilized paired read-aloud strategies promoted by literacy experts on campus. Extensive pair-share methodologies were utilized in class discussions. Whenever possible, students were put in conversation with one another with continual efforts to provide opportunities to get to know each other. These interpersonal pedagogies were intended to build trusting relationships that could offer peer support for students who encounter academic difficulties. The assignments for the class included an identity essay that required students to consider their own STEM identities. Students worked to identify how they considered themselves as belonging in STEM, and to identify experiences that fostered or supported that belonging. This explicit attempt to have students identify specific stories that supported their belonging in STEM aims to build out supportive discourses that could

be relied on when students encountered experiences that introduced doubt regarding a future in STEM.

Outside of class, all but two students were observed working collaboratively in the campus tutoring center where the SEECRS academy instructor works. Two students, one female and one male, appeared socially isolated and over- committed during the course of the quarter. Their outside commitments appeared to heavily strain these two students. Two weeks before the end of the quarter, the female student came to the course instructor's office and reported that she was going to drop out of college to take a couple of quarters off, with intentions to attend the neighboring technical college at some point in the future. The instructor engaged in an animated 30-minute discussion to point out that she had a sizable outside commitment and an extremely difficult course load, and it was the most stressful time of the academic quarter. The instructor advocated finishing out the quarter as strong as possible, with plans for a reduced course load and constraints on her outside commitments. The female student finished the quarter passing all of her classes and deciding to persist. This outcome is juxtaposed with the male student who did not reach out for help or pass most of his classes, and emailed that he had dropped out of school after the subsequent academic quarter had started.

Developing a STEM Identity Class

The development of the initial SEECRS cohort class (SSA) involved multiple stakeholders across campus over an eight-month period. Initial conceptualizations for the course leveraged existing Educational Planning and English courses at the college and an Engineering orientation course at nearby Everett Community College. Preliminary framing for the course included the idea that this course might serve as a template for discipline specific onboarding classes constructed as part of a Guided Pathways model.

Included in the early planning stages were English and engineering faculty, and staff from the Learning Center and Student Success and Retention. Discussions focused on which department the course would be housed in, how many credits it would involve, the nature of those credits (lecture vs lab), and the content to be covered. Through numerous discussions, the SEECRS course was placed within our Educational Planning department, as EDPL 100 courses are currently serving as a general introduction to college for new students (often known as college success courses). The course was eventually offered as a two-credit course meeting one day per week during a time that fit the SSA members' schedules. SSA students were automatically enrolled in the course through the registrar's office. In one instance, enrollment in the course threatened a student's G.I. Bill benefits. That student was never formally enrolled in the course, but it was conveyed that attendance was a condition of the scholarship, and would benefit the student immensely. The student gladly agreed to attend the class.

Throughout the development process, attention was paid to the core intentions of the class. We wanted to introduce students to the disciplines included in STEM, to build community between students, and to strengthen students STEM-oriented identities. To orient students to the disciplines within STEM, it was agreed that students would have four to five lab experiences that were planned and presented by discipline-affiliated faculty. These experiences included a field trip for Geology, the distillation of essential oils for chemistry, a fecal ova float for biology, and the design and manufacture of shoes for engineering. Lab experiences took place during the time the SEECRS course was offered to ensure all students could attend. An optional necropsy of a deceased cow calf two weeks after the academic quarter had ended was also offered in

collaboration with the regional state veterinarian. Nine students attended this additional lab experience, including all the female students in the cohort, and none of the male students.

Year 1 Evaluation Summary

Evaluation Methodology

The evaluation of this SEECRS project has two primary components, a formative evaluation and a summative evaluation. During Year 1 of the project, the formative evaluation is collecting data to describe the main project activities and determine the quality of the implementation of each strategy designed to support SEECRS scholars, specifically the: 1) STEM orientation course and social activities, 2) CUREs, and 3) STEM advising and mentoring. To determine the quality of these project activities during this first year of implementation, the external evaluator conducted a focus group interview with the SEECRS students after the fall orientation course in January 2018 to obtain their feedback on the strengths of the course and their suggestions for improving the course. At the end of the Spring 2018 quarter, SEECRS students will complete a survey that will have them rate the quality of several facets of the project activities. Additionally, in September 2017, the external evaluator administered a brief survey to WCC faculty (N=9) following their first mentor training.

Concurrent with the formative evaluation, we are conducting a summative evaluation to determine the efficacy of the project activities in achieving the intended outcomes. Our research design and analyses have sufficient power to help us answer our primary research question: *To what extent can a guided pathways approach provide a coordinated and supported STEM experience at [college] that (1) increases student success and (2) positively shifts students' STEM self-identity?* The summative evaluation employs a quasi-experimental research design, specifically an "untreated control group design with dependent pretest and posttests" [21]. In Year 1, we are measuring changes in students' STEM identity from October 2017 to May 2018 (i.e. over the academic year) for the SEECRS scholars and a comparison group comprised of the scholars' peers in the Associate in Science- Transfer (AS-T) degree program at WCC. We used two instruments that will allow us to make valid claims about the extent of students' STEM identity. First, we used a modified version of the 12 items from the Science Identity Questionnaire [22] that asks about students' connections to various STEM communities and the extent to which they view themselves as a "STEM person". Second, we used a modified version of the Chemistry Motivation Questionnaire [23], which includes 30 items that measure the following six student factors: intrinsic motivation, extrinsic motivation, self-efficacy, self-determination, goal-orientation, and anxiety-related motivation. The college's Registration Office sent the initial survey by email and text to 281 AS-T students; all 14 SEECRS scholars and 56 students in the comparison group completed the pre-survey.

We hypothesize that the project's cohort, research, and mentoring activities will increase SEECRS scholars' "sense of belongingness" in STEM communities (student, college, and community STEM groups), which will help them develop their "STEM identity". We will administer the Sense of Belongingness scale [24] to measure this construct. This instrument operationalizes "belongingness" in a number of different contexts, including belongingness in student/peer groups, programs/departments, college at-large, and communities outside of the institution. Ultimately, we hypothesize that the scholars' increased sense of belongingness and STEM identity will result in increased success, retention, graduate, and transfer to four-year degree programs.

Formative Evaluation Findings

Faculty Mentor Feedback

We administered a brief survey at the end of the SEECRS Fall 2018 mentor training that introduced faculty to advising theory and the college's Starfish software for organizing their mentoring activities. Faculty (n=9) responded to the two following questions, and we conducted thematic analyses to identify the patterns in their responses.

> Question #1: What questions do you have about the topics addressed during today's meeting?
>
> Question #2: What would you like to learn more about to help you best mentor and advise students?

At the end of the training, participating faculty wanted to learn more about advising theory, mentoring strategies, and STEM career opportunities, and wanted more clarity about the project's expectations for their role as a mentor. WCC employs a staff-advising model, so faculty are not traditionally tasked with understanding advising theory or formalized mentoring roles.

SEECRS Student Feedback

Ten SEECRS students participated in a 90-minute, semi-structured focus group interview at the start of the Winter 2018 quarter, conducted by the external evaluator. The focus group interview contained two questions, one about the benefits of the SEECRS program and one about their suggestions for improving various aspects of the program. In groups of three, students discussed the prompts and recorded their responses. Then the evaluator captured groups' responses to the two questions on the whiteboard, and each student individually rated the extent to which each benefit and suggestion were true for them, on a Likert scale from 1 to 5, with 1 being "Not at all" and 5 being "To a great extent". The two guiding questions for the focus group interview were:

> Question 1: In what ways have you benefited from participating in the SEECRS program? (Think about the ways the various aspects of the program have impacted you, including the fall orientation course, faculty advising/mentoring, social activities, and industry or research experiences.)
>
> Question 2: What suggestions do have to improve the following aspects of the SEECRS program: a) Fall orientation course, b) Faculty advising/mentoring, c) Social activities, and d) Industry or research experiences?

Tables 4 and **5** present student's responses to the above two questions. The responses in the tables are ordered by strength if rating, from the highest to the lowest Likert scale rating.

The focus group comments from the SEECRS students highlight a number of strengths of the program, as well as several areas for improvement, many of which are not surprising given the embryonic stage of the program. While the SEECRS program helped students financially, it also helped them meet like-minded students who provided support, encouragement, and held them accountable for attending classes and completing assignments. They also received encouragement from faculty, which in conjunction helped them develop a sense of belongingness in college. The SEECRS scholars had a number of suggestions for ways to improve the various aspects of the program. One suggestion common to all four main components of the program was the need for the program to be clearer about the overall program

requirements, the goals of the orientation course, the intended outcomes from their work with a faculty mentor, and the expectations for participating in SEECRS sponsored social activities and research.

Table 4. SSA focus group responses to Question 1.

Benefits from Participating in the SEECRS Program	Mean	SD	N
1. Helped me financially	4.75	.71	8
2. Met like-minded students	4.62	.74	8
3. Developed a sense of belongingness in college	4.50	.75	8
4. Received encouragement from other students	4.50	.53	8
5. Received encouragement from faculty	4.37	.52	8
6. Improved documents to help transfer (e.g., personal statements)	4.28	.95	7
7. Developed a supportive peer group	4.25	1.16	8
8. Developed a group that held me accountable	4.00	1.31	8
9. Increased my engagement in school	3.87	1.12	8
10. Mentorship for professional growth	3.87	1.36	8
11. Learned how to transfer to other colleges	3.50	.92	8
12. Leaned how STEM disciplines are related/fit together	3.37	.92	8
13. Increased understanding of career possibilities	3.37	1.41	8
14. Learned about study skills	3.12	1.12	8
15. Participated in research opportunities in my field	1.50	1.41	8

Table 5. SSA focus group responses to Question 2.

Suggestions for Improving the Fall Orientation Course	Mean	SD	N
1. More on logistics of transferring	4.86	.38	7
2. Clearer expectations about goals of the course/course activities (e.g., personal statement for transfer)	4.71	.49	7
3. Clearer expectations about SEECRS requirements (e.g., research component of program) and time commitment	4.43	.79	7
4. More on how to set up independent research	4.43	1.51	7
5. More on study skills	4.28	.76	7
6. More labs	4.28	.76	7
7. More input on content of labs	4.28	.95	7
8. More on how to develop learning contracts	4.14	1.46	7
9. Address challenges/barriers more relevant to me/us	4.00	1.0	7
10. Less on barriers regarding race, sex, etc.	3.57	1.62	7
11. More involvement from faculty from disadvantaged backgrounds	3.28	.95	7
12. No outside labs in crappy weather	3.28	1.70	7

Conclusion and Future Directions

We have made progress across numerous goals from developing the STEM Success and Orientation course, assigning faculty mentors to our first SSA cohort, to developing CUREs for chemistry and engineering courses. We are currently developing an application model for our four summer research scholarships that will involve student-faculty collaborations at WCC and

the nearby regional university. The university is a four-year masters-granting institution with a strong record of undergraduate and graduate research across the STEM disciplines. Some key activities that we are now focusing on developing are:

- We will proactively engage with the partner university to develop a successful transfer strategy that we can deploy with our SEECRS students who transfer. One aspect of this will be to coordinate a one-day visit to the various STEM departments on the university campus for our SEECRS awardees.
- Identify faculty at the university who are willing to mentor our research scholarship awardees in the summer.
- We will launch the program's website and deploy a more deliberate PR effort involving regular press releases and report in the college's Quarterly Newsletter.
- Reach out to our External Advisory Board members and coordinate an annual reporting meeting with them.
- Continued on-campus training for faculty mentors.

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