

**BROADENING PARTICIPATION IN CYBERSECURITY EDUCATION:  
USING AN INTERSECTIONALITY LENS TO UNCOVER NEW PERSPECTIVES**

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**ABSTRACT**

*The three-year participatory action research case study provides an opportunity to uncover the critical outreach role community colleges have in increasing access and broadening participation in cybersecurity career pathways. The research addresses the question: How can learning opportunities for women and minorities be implemented to broaden participation in cybersecurity education? The study achieved its overall goal to increase career awareness and readiness of underrepresented high school students in cybersecurity by implementing an early admit pathway. The study prepared students for: (1) careers in cybersecurity through career awareness, exploration and readiness activities, and (2) college-level sequencing of information computer science and cybersecurity courses. The project successfully recruited women and minority high school students to participate in a college cybersecurity pathway. The lens of intersectionality as a critical inquiry of praxis, illuminates the uniqueness of early admit cybersecurity education programs that focuses on an underrepresented student population that are not often the focus of cybersecurity grants.*

**Keywords:** cybersecurity education, intersectionality, broadening participation, women and minorities

**THE CYBERSECURITY LANDSCAPE: INTERSECTIONALITY OF SPACE, PLACE,  
COMMUNITIES AND GEOGRAPHIES**

The 2018 (ISC)<sup>2</sup> Cybersecurity Workforce study revealed that the cybersecurity skills shortage is growing worldwide. Approximately 1500 cybersecurity and IT experts from North America, Latin America, Asia-Pacific, and Europe responded to the survey. The shortage of cybersecurity professionals is close to 3 million globally in which there is a shortage of 498 thousand in North America ((ISC)<sup>2</sup>, 2018).

According to the survey, 63% of respondents report that their organizations have a shortage of IT staff dedicated to cybersecurity. And nearly 60% say their companies are at moderate or extreme risk of cybersecurity attacks due to this shortage.

The 2018 Frost and Sullivan white paper, *Innovation Through Inclusion: The Multicultural Cybersecurity Workforce An (ISC)<sup>2</sup> Global Information Security Study*, reveals the challenge ahead.

While there are a number of ways to define diversity, this particular study focused on race and ethnicity and defines minorities and people of color as those who do not self-identify as White or Caucasian. This group makes up 26% of the U.S. cybersecurity workforce, which is roughly in line with 28% of the general U.S. population (United States Census Bureau, 2010). In the U.S. cybersecurity industry, 9% of workers self-identified as African American or Black, 4% Hispanic, 8% as Asian, 1% as American Indian or Alaskan Native and Native Hawaiian/Pacific Islander, and 4% self-identifying as “Other.”

In the U.S., 17% of the cybersecurity workforces who identify as a minority are female, proportionally exceeding overall female, proportionally exceeding overall exceeding overall female representation (14%) by a margin of 3%. This demonstrates that the presence of women of color positively impacts workforce numbers and not by simply increasing the quantity of females within the profession. It is worthy to note that North American leads on the world in female participation rates in cybersecurity 14% (Frost & Sullivan, 2017).

Moreover, the 2019 (ISC)<sup>2</sup> Women in Cybersecurity Report assert:

While there is evidence of progress as more women enter into and succeed in the field of cybersecurity, the report also indicates that pay inequities persist. 17% of women globally reported annual salaries between \$50,000 – \$90,000, as compared to 29% of men, and 15% of women earn between \$100,000 – \$499,999, while 20% of men earn at least that much.

This paper challenges the ideas and assumptions about diversity and equity that exist in traditional educational theory by employing an intersectionality lens to broaden perspectives in inclusive ways to mitigate social landscapes that foster marginalization. “Intersectionality is a way of understanding and analyzing the complexity in the world, in people, and in human experience” (Collins and Bilge, 2016, p. 25). Therefore, to achieve clarity of intentions that facilitates us to critically examine mainstream practices we must understand the concept of intersectionality, as a process that develops and illuminate invisibility.

This case study addresses the research question: *How can learning opportunities for women and minorities be implemented to broaden participation in cybersecurity education?*

Community colleges play a critical role in providing access in higher education. However, there are a multitude of factors beyond the individual preferences of community college students and the institutional characteristics of community colleges that continue to face significant challenges related to producing equity in educational outcomes for the wide range of students that they currently serve (Malcom, L. F., 2013).

Moreover, the community college connection to high schools is broad in scope and continues to increase via a number of models that offer early college admit options (Bailey & Morest, 2006; Bragg, 2013). Community colleges are central in focusing on this new wave of America’s high school women and minorities in initiatives to improve their labor market prospects. Community college outreach serve as the critical bridge to address the access and persistence of women and minorities in cybersecurity careers (Nakama, 2016).

The island of Pacific—population 150,203—is one of West Coast’s eight islands. Pacific is diverse, with 21.4% of people reporting two or more ethnicities (Pacific Data Book, 2017). The largest ethnic groups are Native Hawaiian (28.1%), White (26.9%), and Filipino (14.3%; Pacific Data Book, 2017). Native Hawaiians attain bachelor’s degree at a rate (8.3%) over *three times lower* than the national average (30.3%; U.S. Census Bureau, *SI501*, 2016). *Geographical isolation* limits Pacific’s low-income students’ ability to explore postsecondary options as travel to other islands and the continental U.S. is only available by air.

The University of West Coast – Pacific College is a rural hybrid community college. It is the only college offering both bachelors and associate degrees in the ten-campus University of West Coast (UWC) statewide system, which includes seven community colleges and three universities. It is the only college on the island of the Pacific that offers 20 associate and 3 bachelor’s degrees. Through its varied degrees and certificate options, Pacific College addresses the needs of a diverse student population of approximately 3,500 students in a three-island community with its main campus located on Kahului, Pacific. Pacific College outreach education centers are located on Pacific in Nana and Kahaina. Also, the islands of Lolokai and Manai have outreach education centers.

This study highlights an early admit program involving a rural community college that offers a certification in cybersecurity to local high schools via a Bachelor of Applied Science degree in applied business information and technology (ABIT). Additionally, this district-wide program involves high schools with limited or no formal cybersecurity education. Pacific has one school district, Pacific Department of Education, divided by complexes consisting of the primary high school, feeder intermediate school, and feeder elementary schools. High schools on the Pacific island lack access to basic technological services and certified technically trained teachers to teach cybersecurity and computer science.

## METHODOLOGY

This study examined Grade 11 and 12 students who voluntarily enrolled for a semester or more in Pacific College’s Cybersecurity Certificate of Competence. The National Science Foundation CyberCorps Scholarship for Service (SFS) Defending America’s Cyberspace (Award #1516178) paid for college tuition, fees, and textbooks, as well as a recruiter-agent/project coach, faculty, student mentors, and an outside evaluator.

High school students earned college credits while they were still attending high school. The high school students were engaged in cybersecurity education by: (1) enrolling in a sequence of online college level introductory cybersecurity courses; (2) using a cyber environment that combines problem-based learning; (3) participating in hands-on competitions (i.e., Cyber Patriots); and (4) connecting with college/community mentors via academic support and social integration strategies.

The following table describes the Cybersecurity Certificate of Competence (Table 1: Pacific College Cybersecurity Certificate of Competence was a total of 12 college credits and the modality of teaching/learning was online (See Table 1).

**Table 1.** Pacific College Cybersecurity Certificate of Competence Courses (Total 12 credits)

The below list presents the information computer science (ICS) courses and their descriptions for the Cybersecurity Security Certificate of Competency.
<ul style="list-style-type: none"> <li>• ICS 101 - Digital Tools for the Information World: Emphasizes production of professional level documents, spreadsheets, presentations, databases, and web pages for problem solving. Includes concepts, terminology, and a contemporary operation system.</li> </ul>
<ul style="list-style-type: none"> <li>• ICS 110 - Introduction to Computer Programming (Prerequisite: ICS 101 with grade C or better, or consent): Teaches fundamental programming concepts including sequential, selection, and repetition flow; variables and types; syntax; error types; compilation; linking; loading; and debugging. Introduces algorithms flow charts, UMI, and other analytic tools. Explains and offers practice in problem solving and critical thinking methods.</li> </ul>
<ul style="list-style-type: none"> <li>• ICS 184 - Introduction to Networking (Prerequisite: ICS 101 with grade C or better, or consent): Provides the student with the knowledge and skills to manage, maintain, troubleshoot, install, operate, and configure basic network infrastructure, as well as to describe networking technologies, basic design principles, and adhere to wiring standards and use testing tools.</li> </ul>
<ul style="list-style-type: none"> <li>• ICS 171 - Introduction to Computer Security (Prerequisite: ICS 101 or consent): Examines the essentials of computer security, including risk management, the use of encryption, activity monitoring, intrusion detection, and the creation and implementation of security policies and procedures to aid in security administration.</li> </ul>

### Procedures – External Evaluation

The project activities were annually assessed by an outsider evaluator. This paper focuses on the third-year external evaluation of the Post High School Early Admit Cybersecurity Program Survey and the Cybersecurity Early Admit Parent Survey. The Post High School Program Survey consists of 14 questions to highlight accomplishments of program completers, to improve the program and for research purposes. The Cybersecurity Early Admit Parent Survey was administered to highlight accomplishments to improve the program, for research purposes, and to seek additional grant funding. The survey consisted of 14 questions. Nineteen students completed the Post High School Early Admit Cybersecurity Program Survey and eighteen parents completed the Cybersecurity Early Admit Parent Survey.

## RESULTS

Pacific College - Post High School Early Admit Cybersecurity Program Survey. There had an 86% response rate from the Post High School Early Admit Cybersecurity Program Survey. Of those responding 67% were male and 33% were female. This compares favorably with the composition of both cybersecurity nationwide and worldwide. Women globally comprise 11% of the cybersecurity workforce and 14% of the cybersecurity workforce in North America (Frost and Sullivan, 2017).

In regard to ethnicity based upon self-reported data, 25% were Filipino, 17% were Japanese, 8% Hispanic, 17% were White, 8% were Other Pacific Islanders including Native Hawaiians, and 25% Multiple Ethnicities. This is a very diverse composition of ethnicities. Also, little research has been conducted on those with Filipino, Other Pacific Islanders, and Multiple Ethnicities and STEM success. This is truly an underrepresented and under researched population as it related to STEM education.

Filipinos are the second largest ethnic population on the Hawaiian Islands (Libarios, 2013) and the second largest Asian ethnic group in the United States (Panganiban, 2016). Filipinos are disproportionately underrepresented at the University of West Coast - Manoa (Libarios, 2013).

A new item that was explored on the Post High School Early Admit Cybersecurity Program Survey was whether the students were First Generation College Students. Of the respondents, 58% of the students had parents who completed a college or graduate degree while 42% of the students are considered First-Generation College Students. The question was asked so that first generation college students can be further refined. Of the first-generation college students, 20% of their parents did not attend college, 20% had parents with a vocational diploma, and 60% had parents with an Associate's Degree. It is interesting that all of the participants that selected White as their ethnicity were First-Generation College Students. Thus, all of the High School Early Admit completers in this program, met some category of underrepresented student.

The students overwhelming reported that these courses had a positive impact on their lives. All of the students reported that by taking these courses they were more aware of the career opportunities in cybersecurity and were more aware of what is involved in a cybersecurity career. Similarly, all were more prepared to take future classes in cybersecurity and more confident to take college classes in general. Of the respondents, 87% reported that they were interested in taking additional classes in cybersecurity and correspondingly, 87% reported that they planned on doing further studies in cybersecurity.

All students reported that this opportunity would help them be more successful in the future and that they would recommend this opportunity to others. These results demonstrate that the project is successfully accomplishing their goal to increase awareness and preparation of underrepresented college students (women, minorities, and first-generation college students) for matriculation toward a career in cybersecurity.

An important part of the Post High School Early Admit Cybersecurity Program Survey was to find out what the students are doing once they complete the program. Of those completing the program, 25% of the students are still in high school, 8% of the students are at the Pacific College, 25% are at another college in West Coast, and 42% are in college on the US mainland or abroad. All those who had graduated from high school were enrolled in college.

Of those enrolled in college, 43% reported that they are majoring in Computer Science or a Related Field, 43% reported that they are majoring in another STEM Field, and 14% reported that they are majoring in a non-STEM Field. Thus, 86% had been retained in a STEM field. This is a very impressive retention of STEM talent especially with underrepresented students. Of those who have graduated, 44% have already taken additional college classes in cybersecurity.

When asked the open-ended question about what was the most important thing that they learned from participating in this project: 42% reported computer science knowledge; 25% reported that they learned about cybersecurity jobs;

25% reported preparing for college; 25% reported time management skills; 17% reported cybersecurity knowledge; 17% reported how to take an online class; and 8% reported intuitive thinking.

When students were asked how the project benefited them personally, there was a broad range of responses. Selected responses are included in the Table 2: Personal Benefits from the Project below.

**Table 2.** Personal Benefits from the Project

This project has shown me that college can be difficult, and the importance of time management.
I now will have an easier process getting my first job.
I was able to learn more things about cybersecurity and programming in general
I understand basic concepts now, instead of being completely clueless when I go to college.
Personally, I feel that taking these courses have allowed me to grow as an excellent communicator between my classmates and instructor. I have also been able to manage my time more effectively to complete assignments on time.
It helped me in real life with my home network
This project personally benefitted me by teaching me the basic of computer programming in Java. Learning Java gave me the opportunity to learn the skill I need for engineering.
It has taken some financial burden off of me while I can learn more about the field I am interested in.
From doing these courses, I have become more prepared and ahead for college.
This project allowed me to develop better working habits that will follow me into college. While also providing me help in school due to my financial situation, without this program I would have never considered taking these types of classes due to the cost.
It's a great opportunity for high school students to get ahead of their peers and receive credits for no cost to them.

The Post High School Early Admit Cybersecurity Program Survey students were asked an open-ended question about what factors influenced their decision to participate in this program. The most frequently reported response was that they were going into a career in cybersecurity or related field with 42% of the students reporting this response. This was followed by the fact that the course was free which was reported by 25% of the students.

The importance of the good relationship that the project team had with teachers and counselors is reflected in that 17% of the Post High School Early Admit Cybersecurity Program Survey mentioned that they participated at the recommendation of a teacher and/or counselor. Keep in mind that this was an open-ended question which makes this a relatively high response.

When student completers were asked what could be done to improve the program, overwhelmingly the response was that the students wanted more communication between the teachers and the students. Suggestions from students included the following, “more communication between teachers and the students, maybe have the students meet up and talk about how the class is going;” “thank you so much for the opportunity to take these courses. I suggest that there should be more class discussions to help students understand the material better;” and “the classes should have a Skype or a personal connection to the student to allow the student to be more successful”.

Cybersecurity Early Admit Parent Surveys. Parents of the project completers were also requested to complete an online survey. This survey had a similar response rate to the Post High School Early Admit Cybersecurity Program Survey. Of the parents responding, 64% were female and 34% were male. Consistently, the parents felt that this was a positive experience for their children.

Likewise, all parents felt that they themselves were more knowledgeable about what might be involved in a cyber career and 91% of parents responding were more aware of cyber career opportunities. All parents would recommend this project to others.

When asked an open-ended question about the most important thing that their son and/or daughter gained from participating in the Early Admit Program, the most frequent responses reported by 50% of the parents was that it

prepared them for college and similarly 50% reported that their son/daughter learned better time management skills. Other important gains included computer skills which were reported by 30% of the parents.

In addition, cybersecurity skills were reported as the most important gain by 20% of the parents and college credit was reported as the most important gain by 10% of the parents. Note that these percentages add to more than 100% because some parents reported more than one gain.

All parents reported that they encouraged their daughter and/or son to participate in the program. When asked why the parents encouraged their daughter/son to participate in the program with an open-ended question the most frequent response was that it would help them with their future success which was reported by 60% of the parents.

The second most frequent response was that it was a college level class which was reported by 50% of the parents. The courses being free were reported by 20% of the responding parents. The opportunity to take a class online, to learn about cybersecurity and to boost their confidence was reported by 10% of the parents. Again, since some parents reported more than one reason, these responses also total more than 100%.

When asked to select important reasons for their son/daughter to participate, 91% of the parents selected to earn college credit in high school and 91% selected that their son/daughter was interested in computer science before the program began. While 91% of the parents felt that their daughter/son was interested in computer science before the program began, only 55% reported that their daughter/son was interested in cybersecurity before the program began.

The free tuition was an important factor for 82% of the parents. The number of jobs in cybersecurity was important for 64% of the parents, but the number of jobs nearby in cybersecurity was important for 36% of the parents. There was no difference in the ethnicity of the parents and the importance of cybersecurity jobs nearby. The extra assistance that was provided to help them be successful was important for 45% of the parents. The lowest priority was that their friends were also participating which was only selected by 20% of the parents.

When asked how to improve the program, the parents generally felt that the program was “great the way it is”. The only suggestions were “connection with other students and resources” and to “have in-class learning”.

It is interesting that for an open-ended question, there was surprising agreement about the type of gains from this program. Yet, there were some interesting contrasts between parent and high school program completers’ responses.

For parents, the most important gains were related to time management and preparation for college, for high school completers the most important gains were computer skills. One of the most interesting findings, were that time management skills and preparation for college were reported by a large portion of groups, 50% of parents and 25% of Post High School Early Admit Cybersecurity Program Survey. Gains in computer skills were reported by 42% of Post High School Early Admit Cybersecurity Program Survey and 30% of parents. Cyber skill gains were reported by 17% of Post High School Early Admit Cybersecurity Program Survey and 20% of Parents Survey.

The opportunity to have experience with an online class was reported by 17% of Post High School Early Admit Cybersecurity Program Survey and 10% of parents. The final gains were listed by only one of the groups. Only the parents (10%) reported college credit as the most important gain. Only Post High School Early Admit Cybersecurity Program Survey reported preparation for cyber careers at 25% and intuitive thinking 8%.

The two most surprising findings from the Post High School Early Admit Cybersecurity Program Survey and Parent Survey are the importance that both groups placed on the gains in time management and preparation for college. While gains in computer skills and cyber skills were anticipated, the gains in these more general skills are notable. Since underrepresented students such as those in this project are more likely to leave STEM programs, it is important to understand which skills can be developed in high school to help them successfully navigate STEM programs until their completion. When you couple the results of the Post High School Early Admit Cybersecurity Program Survey with the results of survey of students who withdrew from the program along the way and teacher

interviews, time management skills seem to be a major factor in whether students were successful in the program. This merits further research.

This program has been very successful in the recruitment of disadvantaged high school students. Consistently each year the program has had a higher percentage of females and members of diverse ethnic groups than are traditionally represented in cybersecurity. Of the Post High School Early Admit Cybersecurity Program Survey completing the survey 33% were female compared to 11% of the cybersecurity workforce worldwide. In addition, the findings this year's Post High School Early Admit Cybersecurity Program Survey demonstrate that the program has a large percentage of first generation college students. Forty-two percent of the Post High School Early Admit Cybersecurity Program Survey in the program were first generation college students. Every high school completer in the program met some criteria of an underrepresented college student (gender, ethnicity and/or first-generation college student). Many of the students who completed the Post High School Early Admit Cybersecurity Program Survey were of Filipino descent. These students, while belonging to a large and important ethnic group in our society, have not been the target of much research related to their success in STEM fields and cybersecurity in particular.

The student completers and their parents reported that the program had a major impact on their lives. For the parents the most important gains were in college preparation and soft skills like time management. For the students who completed the Post High School Early Admit Cybersecurity Program Survey, these gains were important but they also reported major gains in cybersecurity and computer skills.

The difference in reporting of gains between the two groups makes sense because the students would know more of the specifics due to the skills that they are gaining in the classroom while the parents would be reflecting more on the big picture of changes that they are seeing in their daughters/sons. Despite the differences on the open-ended questions between the Parents Survey and Post High School Early Admit Cybersecurity Program Survey, both parents and high school student completers overwhelmingly reported that the program increased their awareness of cybersecurity jobs and that the program prepared them to be successful in college level cybersecurity courses in the future.

The college credit, financial, and other assistance provided by the grant were important reasons for their son/daughter's participation in the program for the parents. For the students, their interest in a career in cybersecurity or related field, free tuition, and the encouragement of teachers or counselors were the most important reasons to participate.

All the high school completers from the program that have graduated high school are currently enrolled in college with 86% of them enrolled in a STEM discipline. Forty-three percent student completers from the program reported that they were majoring in computer science or a related field. This is an amazing success rate of recruiting and retaining underrepresented students into the STEM pipeline.

All of the high school program completers were more prepared to take future classes in cybersecurity and more confident to take college classes in general. From participating in this project, 92% of the high school student completers were more interested in a career in cybersecurity. Of the responding high school student completers, 87% reported that they were interested in taking additional classes in cybersecurity and correspondingly, 87% reported that they planned on doing further studies in cybersecurity. All students reported that this opportunity would help them be more successful in the future and that they would recommend this opportunity to others. These results demonstrate that the project is successfully accomplishing their goal to increase awareness and preparation of underrepresented college students (women, minorities, and first-generation college students) for careers in cybersecurity.

Throughout this project, students, early-admit high school program completers, parents, teachers, and stakeholders have consistently reflected on the success of the program. Students, parents, and even those who withdrew from the program have reported an increase in awareness about cybersecurity jobs. Amazingly, even 88% of the students who withdrew from the program reported an interest in taking courses in cybersecurity in the future. Of the project

Post High School Early Admit Cybersecurity Program Survey that have graduated high school all are enrolled in college and 86% are majoring in a STEM field.

The limitation of this study is that is focused on one rural state population. If this model is implemented in other rural areas in the future it will add to the understanding of the under-represented rural populations in cybersecurity degrees.

#### **SUMMARY**

This case study has successfully achieved its overall goal to increase awareness and readiness of underrepresented high school students for successful matriculation into careers in cybersecurity by implementing an early admit cybersecurity career pathway for high school students. The study has also successfully met its objectives to: (1) Prepare students for careers in cybersecurity through career awareness, exploration and readiness activities and (2) Prepare students for college-level course cybersecurity program of studies through sequencing of information computer science and cybersecurity courses.

The study successfully recruited women and other underrepresented high school students to courses that would prepare them for a cybersecurity pathway. Overall, 32% of the students participating in the project were Native Hawaiian or Part-Hawaiian. Over the three years, 39% of the participants were female. Throughout this project, students, parents, teachers, and stakeholders have consistently reflected on the success of the program. Parents and students (even those who withdrew from the program) have reported an increase in awareness about cybersecurity jobs. Amazingly, even 88% of the students who withdrew from the program reported an interest in taking courses in cybersecurity in the future. Of the project third year cohort that have graduated high school, all are enrolled in college and 86% are majoring in a STEM field.

The intellectual merit of the study is that it demonstrates that an Early Admit High School Program in Cybersecurity can increase awareness and readiness of underrepresented high school students for successful matriculation into careers in cybersecurity by implementing an early admit cybersecurity career pathway for high school students. Additional intellectual merit for this project is that it provides insights into the importance of time management skills for the success of underrepresented students taking early admit cybersecurity classes while in high school.

This study provides insights into an under researched but important group of underrepresented college students, Filipino Americans in the Pacific. Similarly, it provides insights into the recruitment and retention of first-generation college students into cybersecurity. Finally, it establishes that online introductory cybersecurity certification of complete to remote rural sites has been demonstrated effective under certain conditions (e.g. long-term relationships established, support, changes happen on both sides of the education sector not just on one side).

Two of the major strengths of this project are their focus students' intersectionality with institutional practices, a critical inquiry and praxis for continual improvement. The project was not satisfied, as many projects would be, that their early admit students were performing somewhat better than traditional college students. The project team immediately sought to gather information and to act upon the information that some students were withdrawing from the program to further improve this project and to reduce the number of students failing or withdrawing from the program. Information was gathered from the following sources, student surveys, surveys from students who withdrew from the program, and interviews with the project leader, the new teacher, and the grant coach to help understand why students were withdrawing.

In addition to looking at recruitment of women and other underrepresented students into the cybersecurity pipeline, for the program to be successful, it is important that these students are successful within the pipeline once they enter. The data indicate that the success rate of the early admit students was also higher than the success rate of the traditional class. Again, it is important to note that both classes had the same instructor. This demonstrates that while there is room for improvement in the success rate of the early admit students, the students compare favorably to the success rate of a traditional class.



One of the immediate responses to try to increase the student success rate was the hiring of a new teacher for the program. The new teacher assumed the role of teacher for the program in January of the second year. She is taught ICS 184 in the spring and followed by ICS 171 in the summer. She is uniquely qualified to teach in this project due to her extensive background in cyber and information security. She also felt that the student population and the format of the course (online) created specific challenges that needed to be addressed to maximize the success of the students and to allow for replication of the program on a wider scale. The changes in course design reflected the project's commitment to accessibility, so that all learners can access all course content and activities, and to usability, so that all learners can easily navigate and interact with course components (Nakama & Paulette, 2018).

The broader impact of this program is that it has been successful in recruiting and retaining underrepresented students both women and minorities into the STEM pipeline. The study's innovative approach of recruiting students from the Arts and Communication pathway rather than only the STEM pathway is a lesson that can be replicated nationally. Therefore, this program is working toward meeting the cybersecurity needs of the United States. The underrepresented students in this program (e.g. Native Hawaiian, Filipino, multiple ethnicities) are not often the focus of National Science Foundation grants. In addition to the recruitment of women and ethnic minorities into the cybersecurity pipeline, the project has also successfully recruited and retained first generation college students. The definition of underrepresented students was expanded to include these first-generation college students as the grant progressed as part of the iterative process of evaluation. In addition, women and minorities may also be first generation college students.

Access to opportunities to engage with STEM is a crucial issue of equity; however, it not the only issue of equity (Bevan, B., Barton, A. C., and Garibay, C., 2018). The project took into consideration the specific cultural context in which it was working and maximized the community assets to make the program more effective. The three-year case study highlights how to: (1) cross educational sector boundaries to transition from internal optimization to external interaction; (2) orchestrate resources to create a learning collective space; and (3) use intersectionality, a critical theoretical perspective, to discover creative ways to engage a broader, more diverse group of students in cybersecurity. Often there is a six-year delay between high school graduation and minorities entering the Pacific College Cybersecurity Program, the project has potential to close this gap.

Researchers, policy makers, scientific funding agencies, businesses/industries, educational institutions and practitioners are investing significantly in the recruitment and retention of cybersecurity skills pipeline shortage that has been growing worldwide. Bringing an intersectionality lens to understanding underrepresented students provides a clearer view of how to retain rural, underrepresented students into the cybersecurity pipeline. From the convergence of intersectionality and education, we used a critical inquiry of praxis sensitivity to space, place and geography as a tool for social justice and broadening participation in cybersecurity (Collins, P. H. & Bilge, 2016; Grazanka, P. R., 2014). It our hope that this research can serve to assist others to broaden their perspectives on broadening participation in cybersecurity within the confines of large, bureaucratic, often patriarchal systems.

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