Abstract

In this session, we look at a local rural consortium and explore the relationship of collaboration and cybersecurity education to create and nurture a diverse learning community. The session will focus on three themes: context, convening, and design/processes.

Introduction

The project’s overall goal is 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 project’s objectives are to: (1) Prepare students for careers in cybersecurity through career awareness, exploration and readiness activities. (2) Prepare students for college-level course cybersecurity program of studies through sequencing of information computer science and cybersecurity courses.

The study used an iterative action research process for continuous improvement in our teaching and learning techniques. (See Figure 1 below.)

Table 1: Project Deployment

<table>
<thead>
<tr>
<th></th>
<th>FALL SEMESTER</th>
<th>SPRING SEMESTER</th>
<th>SUMMER SEMESTER</th>
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</thead>
</table>

Cybersecurity College Certificate - College Early-Admit Program. The following is a listing of the course (ICS - Information Computer Science) and the course descriptions.

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. 3cr., 3hr. lect./lab

ICS 169 - Introduction to Information Security - Prereq: ICS 101 with grade C or better, or consent. Provides the basic foundation to information security, including identifying threats, planning for business continuity, and preparing for various security attacks. Focus will be given to threats to financial security such as attacks on banking and other related financial information. Special emphasis on ethics and legal issues that covers hacking and other cybersecurity techniques and tactics. 3cr., 3hr. lect.

ICS 184 - Introduction to Networking - Prereq: 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. 3cr., 3hr. lect.
ICS 171 - Introduction to Computer Security -
Prereq: ICS 101 or BUSN 150, 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. 3cr., 3hr. lect.

Highly Recommended Course: ICS 110 - Introduction to Computer Programming - Prereq: ICS 101 or BUSN 150, either 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. Introductions algorithms, flow charts, UML, and other analytic tools. Explains and practices problem solving and critical thinking methods. 3cr., 3hr. lect.

Analysis – First Year Evaluation

Demographics of Cohort One and Cohort Two. The project proposed to engage at least 72 underrepresented high school students with core topics in cybersecurity over two years. The First Cohort of students in Spring 2016 contained 41 students and in summer 2016 Cohort Two consisted of 43 new students. Thus, during Year One of the grant 84 students have already participated in the project. This surpasses the expectation for the entire two years of the grant. Figures 2 and 3 show the Gender Distributions of the cohorts. For both cohorts, females outnumbered males.

The project for year one was evaluated by an external evaluator via online surveys, a site visit to the University of Hawaii Maui College (UHMC), interviews with PIs, follow up data on students, and attendance at the Advisory Board meeting.
Figure 4: Ethnicity of Cohort One*
Figure 4. demonstrates considerable diversity of ethnicity for Cohort One.
(*Data is normalized on ethnicity records versus student records where there may or may not be multiple ethnicity records per student record.)

- Filipino
- Japanese
- Caucasian
- Chinese
- Korean
- Native Hawaiian/Part-Hawaiian
- Thai
- Hispanic
- Vietnamese
- Samoan

But Native Hawaiians/Part-Hawaiians increased from 7% to 19%. (See Figure 5.)

Figure 5: Ethnicity of Cohort Two*
(*Data is normalized on ethnicity records versus student records where there may or may not be multiple ethnicity records per student record.)

- Filipino
- Japanese
- Caucasian
- Chinese
- Korean
- Native Hawaiian/Part-Hawaiian
- Thai
- Hispanic
- Vietnamese
- American Indian/Alaskan Native

However, the cohort did not adequately reflect the available population of Native Hawaiian/Part-Hawaiians. Therefore the project explored ways to attract more Native Hawaiian/Part-Hawaiians to the cyber pathway. The project recruited through an Open House, which included parents and through a Senior Counselor. The project personnel went to private schools with a high percentage of Native Hawaiians. They were able to recruit 8 students from these 2 private schools.

An innovative strategy to reach Native Hawaiians/Part-Hawaiians was also used by this program. In addition to traditional STEM recruitment, they recruited students from the Arts and Communication pathway. This program has a higher concentration of Native Hawaiians/Part-Hawaiians and served as a successful, innovative way to recruit students into cybersecurity. Thus, from Cohort One to Cohort Two the percentage of Native Hawaiians/Part-Hawaiians increased from 7% to 19%. From Cohort Two, the project was able to collect additional, valuable survey data. Thirty students completed the survey. From this survey, we were able to discern what excited them about being an UHMC Early Admit Student.

Students were allowed to select more than one option from a checklist that also allowed them to select Other and to fill in an open-ended answer. The most popular answer was New Classes with 86.67% of the students selecting this option. The second most popular response was Friends Enrolling with 43.33% selecting this option. New Teachers and Other tied for third most popular response with 16.67% selecting each of these options. The open-ended answers for Other are contained in Figure 6.

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When asked to rank order their plans for after graduation, it was evident that most planned on attending college. Neither work nor the military was any of the students’ first choice. Work was the second choice for 6.67% of the students. The number one choice for the majority of the students (58.62%) was to study on the Mainland US or abroad. The second most popular number one choice was study in Hawaii, which was selected as the number one choice by 23.33% of the students. This was followed by UH Maui College which was selected as the number one choice by 20.69% of the students. College in Hawaii was the second most popular choice for 70.00% of the students. This was followed by study on the Mainland or abroad at 13.79% and UH Maui College at 10.34%.

Students were asked to rank order the following items as to what would increase their interest in Cybersecurity: (1) more information about what the job might entail, (2) access to more relevant classes to see if I would be good at it, (3) reassurance that I would earn a good living, (4) opportunity to speak to current professionals about the pros and cons, (5) if my friends thought it would be a cool career, (6) if my parents thought it would be a good career, and (7) nothing. (See Figure 7 and Figure 8.)
Table 2: Reason Enrolled-Open Ended Responses Categorized
(Data is normalized on multiple student choices.)

<table>
<thead>
<tr>
<th>Reason</th>
<th>Percentage (Number of Students)</th>
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</thead>
<tbody>
<tr>
<td>College Credit</td>
<td>32.1%</td>
</tr>
<tr>
<td>Counselor</td>
<td>7.1%</td>
</tr>
<tr>
<td>Teacher</td>
<td>35.7%</td>
</tr>
<tr>
<td>Understanding cybersecurity</td>
<td>17.9%</td>
</tr>
<tr>
<td>Safe online</td>
<td>7.2%</td>
</tr>
<tr>
<td>Friends</td>
<td>17.9%</td>
</tr>
<tr>
<td>Free</td>
<td>21.4%</td>
</tr>
<tr>
<td>Learn something new</td>
<td>10.7%</td>
</tr>
<tr>
<td>Benefit my future</td>
<td>7.1%</td>
</tr>
<tr>
<td>Possible career</td>
<td>7.2%</td>
</tr>
<tr>
<td>STEM conference</td>
<td>3.6%</td>
</tr>
<tr>
<td>Technology</td>
<td>10.7%</td>
</tr>
<tr>
<td>Family</td>
<td>3.6%</td>
</tr>
<tr>
<td>Interest STEM</td>
<td>3.6%</td>
</tr>
</tbody>
</table>

Cohort Two was asked in two different ways why they took the class. First they were asked whether they agreed with certain statements as to why they took the class. Secondly, they were able to write in an open-ended answer as to why they took the class.

When asked if they agreed with the statement, “I took this class to see what Cybersecurity is all about,” 82.1% either agreed or strongly agreed. For the statement, “I took this course to see where Cybersecurity is applicable,” 71.4% either agreed or strongly agreed. The lowest agreement was with “I took this course to understand the Cybersecurity issues in business” with half of the students either agreeing or strongly agreeing.

Advisory Board Recommendations. One recommendation of the Advisory Board was to make sure that there is not a misunderstanding on how students are recruited into the program or the definition of the purpose of the Cybersecurity Early Admit program. Currently, no high schools give credit for the courses.
According to the Advisory Board, the programs should explore whether some schools could give students elective credit for the courses. Another recommendation was to do additional outreach to counselors. This was already being addressed as the PIs had plans for a Counselors Workshop.

The PIs also plan to bring together high school principals. Additionally, board members said that students should be encouraged to participate in cybersecurity competitions. They also said that it was very important that help, such as that provided by Coordinator and Recruiter (Randy Yamanuha), and peer mentoring (UHMC undergraduate student) increase as students enter into networking classes. It was suggested that the project look at ways to expand to middle schools.

One point that was brought up at the Advisory Board meeting was that there is often a six-year break between when minorities graduate high school and when they enter the UHMC Cybersecurity Program. This grant may provide important insights into strategies to close this gap. Overall the Advisory Board was unanimously impressed with the project and the project’s outreach.

Discussions and Themes

We are also seeking feedback from the audience who are conducting similar research.

- How do you create collaborative synergy among academic partners across K-12 and higher education institutions including industry/business to:
  - Raise awareness of cyber risks and promote cyber safety and security in the community at large, including small and medium businesses.
  - Facilitate the recruitment of all students into the cybersecurity workforce.
  - Grow interest in cybersecurity careers among students in grades 6-12 for scaling broader participation.

- How do you collaborate with other academic institutions across K-12 and higher education and business/industry to enhance cybersecurity curriculum in a timely manner to maintain the relevance of cybersecurity curriculum?

- How do you facilitate continuing education and training for existing workforce to maintain current skills in cybersecurity occupations?

Session Feedback - Survey Monkey link:

https://www.surveymonkey.com/r/QZQHPSR

Outcomes – First Year

The goal of this session is to present what community college outreach looks like in practice and provide an understanding of how we work with our local high schools. The audience should leave with a better idea of the role of community colleges in rural communities. They should get an understanding of the most common challenges we face and some methodologies used to solve them. We hope to convey that knowing the complexities and challenges that early admit possesses has never been as important due to the increasing need for the community colleges to provide trained workers for the cybersecurity workforce.

Intellectual Merit. The Intellectual Merit of this project is that it provides some valuable insights into what motivates underrepresented students to participate in Cybersecurity Early Admit Programs and to consider Cybersecurity as a Career. For example, while family and friends were not considered a major factor in convincing students to consider a cybersecurity career, friends did play a major role in the students enrolling in this Early Admit program. More information and availability of relevant courses played the most prominent role in considering a cybersecurity career.

Broader Impact. The Broader Impact of this project is that it provides valuable lessons for ways to recruit underrepresented students into Cybersecurity and how to help them be successful once they are in the pipeline. 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 project’s innovative approach of recruiting students from the Arts and Communication pathway rather than only the STEM track is a lesson that can be replicated nationally. The project also demonstrates the importance of additional resources that need to be provided to the students to help them to be successful.

This project is also having a very direct impact on the underrepresented students in the program, which is broadening and diversifying the cybersecurity pipeline. Through its innovative recruitment and retention program, it is successfully recruiting and retaining underrepresented students into the cybersecurity pipeline. Similarly, it is introducing underrepresented
students to cybersecurity earlier. Often there is a six-year delay between high school graduation and minorities entering the UHMC Cybersecurity Program, the project has potential to close this gap. The project has disseminated its findings at several professional conferences.

**Presenter**

Dr. Debra A. Nakama is the PI for National Science Foundation (NSF) Scholarship for Service (SFS) study: Addressing the Need for Women and Minorities in Cybersecurity: A High School Early Admit Study, a two-year study designed to increase the number of minorities and women succeeding in college level cybersecurity education and degree programs at UHMC. Dr. Nakama has more than two decades of implementing federal workforce and economic development career pathways from middle school to community college to the workforce. Through a K-20 cross-level teacher and administrators collaborative, Dr. Nakama designs career program of studies using systemic intervention strategies as a way of informing K-12 and college stakeholders of effective methods for increasing the college transition rates of underachieving and underrepresented students.

**References**


