Using Research to Ensure Equity in a Cybersecurity Education Pathway

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***Abstract*—This poster describes how we are using research to inform the development of a cybersecurity education pathway to attract and retain students from groups that are underrepresented in computing fields. The partners include a non-profit research organization, a community-based tech workforce center, a community college, and a K-12 school district that serves predominantly Latinx students. The poster describes our goals, activities, the data we have collected, and how they are being used to create a sustainable pathway from high school to college that attracts a diversity of students. We describe our stages of research utilization, as well as the challenges that we are facing related to using research to ensure equity in the cybersecurity education pathway.**

Keywords—equity, cybersecurity education, K-12 community college, research-practice partnerships

I. Introduction

Cybersecurity education is a growing area of computer and information science. However, there is a global shortage of professionals in information security, and companies are not staffed by a population that represents the diversity in the US (CyberVentures, 2019; Reed & Acosta-Rubio, 2018). Career-themed pathways that integrate college preparatory academics, rigorous technical training, work-based learning, and support services can help students get and stay on track (Caspary & Warner, 2016). But creating sustainable pathways to attract and retain students from groups that are underrepresented in computing fields is a challenge.

This poster describes how we are using research to ensure that pathway development and implementation follow an equitable and inclusive approach to computing education. We are building a cybersecurity-focused computer information systems (CIS) pathway from high school (HS) to college in a majority-Latinx district. Our cross-institutional partnership includes non-profit researchers, a large school district, a community-based technology center and a community college.

Data are being used to understand who enters the pathway, to monitor student participation in on-ramps and their movement along the pathway, and to understand what services are needed to recruit and sustain participation as well as the structural and cross-organization challenges to providing them. The interpretation of local data is guided by empirical and theoretical research in the field of computer science education, including research on equitable approaches to computing education (Margolis et al., 2012). Our work is driven by a Research-Practice Partnership that aims to ensure that the research addresses both local needs and critical research questions (Coburn & Penuel, 2016).

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Our process for using research to inform practice is based on a multi-stage conceptual framework of research utilization: 1) identify available and needed knowledge (acquisition), 2) create processes and routines to incorporate it into practice (assimilation) or new solutions (transformation), and 3) apply the knowledge to new problems (exploitation) (Cohen & Levinthal 1990; Zahra & George 2002). In this poster, we describe our accomplishments to date and how our collaboration moves through the stages of research utilization. We also highlight the challenges we face with generating and using research to ensure that our work maintains an equity lens throughout pathway development and implementation.

II. Pathway Development

A major focus of our work is on building the pathway. A team of teachers, faculty, counselors, and staff from the college, school district, and community-based organization are working to delineate a series of on-ramp programs after school and during the summer, offer high school classes with student outreach strategies, build a system of articulation from high school to college, provide student supports, coordinate implementation across sites, align the pathway with district initiatives, and monitor student participation. At the end of Year 1, we established key onramps and the first pathway class, where enrollment increased from 63 students in 2018-19 to 149 students in 2019-20. In the next sections, we describe the stages of research utilization that are informing pathway development..

III. Identify Available and Needed Knowledge

An early step was to create a database of relevant research and summaries of existing data. For example, the team used publications on Linked Learning pathways (ConnectEd, 2013) and Aligning Systems for Equity (SRI, 2019) to identify steps for building a path that includes rigorous academics as well as real-world technical skills and personalized supports. Summaries of existing data from student transcripts were used to identify needs, including existing gender imbalances in CIS on-ramps and classes at both the high school and college level. These data are being used to inform the development of recruitment and retention strategies.

IV. Collect and Analyze Data

Additional data are being collected to understand students' motivations for entering the pathway, who persists, and what kinds of supports, services and systems can help. These include interviews with students, school district and college administrators, teachers, and counselors. The findings are informing student recruitment and class implementation. For example, the CIS classes attract students that like math, science or technology. They enjoy the hands-on activities, learning things they can readily apply outside of class, and working with other students. The data show that CIS classes

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attract a range of students when they highlight the hands-on and creative nature of the class, give details about what they will learn, and help students see that they have the skills to succeed in the class.

Data from the school administrator interviews are informing pathway development and system alignment. They are helping the team build on school and district priorities for career technical education, including certification, dual enrollment, and work-related experiences, and connect to other subject areas and college and career support systems. The data are also being used to identify structural factors that will need to be addressed in order to support and sustain the pathway. These include helping school staff understand the different areas of computing and how they connect to specific college majors or careers and addressing both the lack of teachers with tech industry experience and inequitable internet access.

V. Create Processes and Routines to Utilize Research

Our team is utilizing both external and local data to ensure an equitable pathway. To make external research accessible, we summarized key articles on a specific topic in a "what to read" document to provide quick answers to questions and share a "research minute" at team meetings. Strategies for making local data "actionable" include data visualizations that summarize student participation and motivation, and thematic summaries about how students have been impacted, with illustrative quotes. The Superintendent has asked for regular data summaries (what she calls "tidbits") that she can share with various stakeholders. We are also creating longitudinal case studies of students to show patterns of course enrollment and grades that led them to take CIS classes or on-ramps, as well as their current goals and interests. These data are being used to identify what services and supports are needed to keep them on the pathway.

Team discussions explore the application and limitations of data. For example, when we found that two thirds of students in the first pathway class knew nothing about the topic before enrollment, these data were used to show the need for the class. Similarly, longitudinal case studies of students' course enrollment and grades led to a conversation about which students to target for the on-ramp classes. And our summary of course enrollment data led to a consideration of whether the next class in the pathway should be dual enrollment when we found that most students were just in 9th grade and not prepared for college-level work.

VI. Apply Knowledge

Collecting data is much easier than applying it. One challenge is that when new data are collected, analyzed, and summarized, they are not always actionable. For example, while our data show that the classes and camps attract more male students, they do not provide insight into why this is happening or what strategies would be effective to address this disparity. A second challenge is that institutional data is not designed to answer questions about systems or students' goals and motivations. For example, the district's college and career readiness platform produces data to inform the student, their family and their counselor. The platform was not designed to help researchers track changes in their goals and interests. A third challenge is that there is limited external research on how to build a coordinated, cross-institutional pathway in cybersecurity education that focuses on equity. In particular, there is very little research on how to engage and support thigh school Latinx students in computing fields.

VII. Conclusion

This poster describes how a collaborative of four organizations is working together to design and implement a cybersecurity education pathway in a majority Latinx community. The goal is to recruit and retain a diverse group of students from high school into college in a field of study that has a growing workforce. The partners have identified "research" as an important component to ensure the success of a pathway that maintains a lens of equity and inclusion. In this poster, we described the accomplishments to date and the stages of research utilization that the collaborative is going through. We also described some of the challenges to using research knowledge as we build an education pathway..

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