Validating prior research: a qualitative study of the career perspectives and experiences of female cybersecurity professionals

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Abstract

The purpose of this study was to validate the theoretical assumptions of the Cybersecurity Engagement Model (CEM), shown to demonstrate validity in identifying four factors - Awareness, Support, Intrinsic and Extrinsic characteristics, which may lead females to the cybersecurity field. Ten female cybersecurity professionals were interviewed to learn their perceptions of the cybersecurity field as they describe factors and barriers encountered during their education and early career. The results of this research lead to a better understanding of these factors and provide holistic insight to academicians and practitioners for their use during the education, recruitment and development of future cybersecurity professionals.

Introduction

In their earliest years, children are "natural scientists, engineers and problem-solvers" (Murphy, 2001); unfortunately, upon completing middle school, over 50% of students are no longer interested in education or careers in science, technology, engineering or math (i.e., STEM) fields. Others feel, however, that students have not lost interest by that age, rather they have never been aware of opportunities for careers in these fields (Anderhag et al., 2016; Terrell et al., 2019)

Unfortunately, this leads to an underrepresentation of women in information systems degree programs and careers such as cybersecurity. This is evidenced by the 2022 Cybersecurity Workforce Study (ISC2, 2022) showing that the number of women in the cybersecurity workforce increased by only 13% (i.e., 11% to 24%) between 2015 and 2022 (Suby, 2015a; Suby 2015b, ISC2 2022). On-going research is needed to better understand this problem, as well as develop ways by which females can be equitably represented in the field.

The research study herein investigates the perceptions of 10 current female cybersecurity professionals as they describe factors and barriers encountered during their education and early career in the cybersecurity field. The goal is to better understand these issues and validate a previously developed cybersecurity theory that provides holistic insight to academicians and practitioners in educating and developing future cybersecurity professionals.

Research Goal

Prior research resulted in the development of the Cybersecurity Engagement Model (CEM) in which four themes were identified as factors that could attract females to a career in the cybersecurity field (Lingelbach, 2018). These include Awareness, Support, Intrinsic factors and Extrinsic factors.

Awareness and Support

Many young females are not aware of the overall information systems field. To address this, programs starting as early as elementary school have been shown to be effective in positively developing their awareness and interest in the STEM fields (i.e., Science, Technology, Engineering & Math) (Terrell et al., 2019). Awareness can be achieved through involvement in STEM conferences, educational programs and summer camps. Support for these activities can be positively influenced by a wide range of individuals and networking groups including STEM professionals, educators, role models, and mentors, and can be used as an integral part of curricula at all levels (Luttenberger et al., 2019).

Intrinsic and Extrinsic Factors

Intrinsic motivation is defined as a desire to engage in an activity primarily because of personal interest, and has been shown to be positively affected if related topics are introduced in a timely and informational manner (Deci & Ryan, 1985; Ryan & Deci, 2018). In focusing on adult females employed in the cybersecurity field, Lingelbach (2018), found intrinsic motivation defined as a "natural interest in the cybersecurity field, seeing the field as challenging and fun, exciting and rewarding".

While intrinsic motivation is developed from within an individual, extrinsic motivation is focused purely on external rewards such as a higher salary or grades, a sense of recognition and contribution, or advancement within an organization. While a task might not be personally perceived, in and of itself, as rewarding, many students and employees will continue performing at an expected level in order to receive the given rewards.

The vital role of intrinsic and extrinsic motivation, as they contribute to success in the information systems field, has long been noted (Hwang & Yi, 2002; Singh, 2016). While most agree that the underlying theories of both still apply, it is agreed that educators, managers and supervisors should be aware of the need to balance both. This can be the catalyst for success for information systems students and employees.

The Purpose and Research Questions

The purpose of this research is to validate the cybersecurity engagement model (CEM) proposed by Lingelbach (2018) through exploration of the experiences of 10 female cybersecurity professionals. The aim of this research was to gain a comprehensive understanding of the challenges, motivations, and strategies employed by women in the cybersecurity field, and to examine the extent to which the findings align with or expand upon the existing theory. Validation was based on the analysis of interview data focusing on five questions:

1. What is your education and experience in the cybersecurity field?
2. Why did you enter the cybersecurity field?
3. How important is it for women to be involved in cybersecurity? Why?

4. What barriers did you overcome to be able to pursue the cybersecurity field?
5. What can help strategies and engagement factors young women in pursuing the cybersecurity field?

Methodology

A phenomenological approach was used for this study. Interviews and a review of relevant documentation and literature allowed researchers to better understand the lived experiences and perspectives of the participants who shared similar experiences (Creswell, 2009; Creswell, 2013; Terrell, 2023).

A purposive sample of ten female cybersecurity professionals from various organizations and roles within the field was recruited. Respondents ranged in age from 26 to 60, with an average age of 44. Higher education backgrounds varied by discipline (e.g., information systems, business, higher education) and degree awarded (i.e., Associates, Bachelor and Graduate). All participants held a form of industry certification (e.g., CISSP, Security+, CISA) and had worked in the information systems security field an average of 15.5 years.

The respondents agreed to individual online meetings and semi-structured interviews were conducted, allowing participants to share their firsthand experiences, perceptions, and insights related to their careers in cybersecurity. The interviewer used a narrative approach by using semi-structured questions, based on the study's research questions, to better understand the problem area and firsthand experiences. The interviews were video and audio-recorded, transcribed, and thematically analyzed to identify recurring patterns and emergent themes.

Data Analysis

In order to accurately understand the data collected, the authors began by reading the transcripts looking for "events, experiences, accounts of things that happened and the details of the actual narrative" (Terrell, 2023, p. 183). This approach led to the development of two overarching themes.

The Importance of Females in the Cybersecurity Field

There was unanimous agreement on the importance of females in cybersecurity with the vast majority focusing on the unique skillset females contribute, e.g., "If literally half of our workforce is not participating in that industry, we've lost the faces of people who are not the traditional majority. We've lost perspectives from people who may think a different way." Other supportive insight included, "I think a lot of the very deeply technical men in cybersecurity lack a significant amount of empathy, and they don't consider the human component nearly as much, if at all, nearly as much as they should." The importance of females in cybersecurity was summarized by a participant's observation that, "I think it would be a good balance to … include more men and women and just people of different strengths and diversities."

Entering the Cybersecurity Field and Perceived Barriers

Reasons for entering the cybersecurity field were two-fold. First, the majority of respondents felt that their hiring, or relocation within an organization, was based on the demonstration of, or an expression of interest, in skills that were considered key to the field, e.g., existing security processes and procedures within an organization. Others focused on the cybersecurity profession while in college e.g., "I took a security and risk analysis course which was in the College of Information technology and I really enjoyed it, so I ended up enrolling in a couple of other classes within the college and then enjoyed all of them."

While many of the respondents perceived no barriers, others remarked on perceived gender inequality e.g., "We don't have someone necessarily always looking at us, especially when our colleagues tend to be male", while others noted responsibilities expected of them outside the working environment that might possibly act as a potential barrier, e.g., "So I think as a woman you naturally you naturally deal with different things in your life such as raising your family. So sometimes you have some additional distractions that sometimes males don't have."

Discussion

The data analysis confirmed and expanded aspects of the Awareness, Support, Intrinsic and Extrinsic factors, identified by the Cybersecurity Engagement Model (CEM). Early experiences such as exposure and education, STEM programs, and summer camps can lead to increased awareness, interest and knowledge in the STEM field. Support for females considering a STEM career can be afforded by individuals and groups currently working in the STEM field; this could include family members, attendance at industry conferences and industry role models and mentors (Lingelbach, 2018). Working together, the CEM intrinsic factor can be developed and improved by offering educational and career opportunities that are seen as challenging and fun, exciting and rewarding'(Lingelbach, 2018). Employers must then support the extrinsic factor with realistic salaries, by supporting employee independence and ensuring a rewarding sense of participation and contribution.

Future research in this field is called for in order to ensure its applicability to females from all ethnic, racial and socio-economic populations (Allen-Ramdial & Campbell, 2014). This could lead to the identification of other factors and strategies to encourage females in the cybersecurity workplace.

Conclusion

Despite their recognized potential for success, females are under-represented in the cybersecurity field. With this, females lose the opportunity for learning and growth, while industry misses the insight from different perspectives that a better gender balance could bring. This, many feel, can be addressed by ensuring increased awareness and interest in the field, beginning in middle and high-school classrooms. Activities could include clubs in high school mentored by experts in the field, a focus on cybersecurity in information systems classwork and conversations with females in the field, be it university students or others currently employed in the security field. Females should also be made aware of, and take part in, organizations such as WiCyS (Women in Cybersecurity), the International Consortium Of Minority Cybersecurity Professionals (ICMCP) and Girls Go Cyber Start that offer female students opportunities to gain knowledge and experience, as well as identify mentors and other networking opportunities. Regardless of the approach, there are many initiatives and opportunities focused on closing the cybersecurity gender gap.

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