

Solving the Cybersecurity Challenge: Students' and Educators' Views on Cybersecurity Competitions

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ABSTRACT

There is a growing body of literature suggesting that cybersecurity competitions are an important tool for increasing the interest in cybersecurity in light of an urgent need for cybersecurity specialists. At the same time, students rely on their advisors and mentors to be well prepared for these extra-curricular activities. This paper assesses the extent to which educators' and students' views on cybersecurity competitions overlap and to which they differ. The data for the study was collected through three surveys: two, offered to students at Capture the Flag (CTF) events, organized by a higher education institution in Virginia, and one - to teachers/professors who participated in the Virginia Cybersecurity Education virtual conference. Based on the results, we make recommendations how benefits related to cybersecurity competitions can increase for both sides, as they continue to work together to close the cybersecurity skills gap.

KEYWORDS

Cybersecurity, Mentors, Cybersecurity Competitions, Cybersecurity Skills

INTRODUCTION

Reports about the growing need for cybersecurity professionals and the lack of such continue to emerge and highlight this alarming tendency despite some progress being made to meet this demand (Lake, 2022). Estimates show that there are 469,930 unfilled jobs in the U.S. in 2024 with slightly above 1.2 million jobs in the same sector being filled (CyberSeek, 2024). Globally, projections point to 3.5 million job openings in 2025 (Morgan, 2021). Efforts to mitigate the issue are made by the U.S. federal government through grant programs and purposeful recruitment of cybersecurity professionals, by the private sector through offering competitive conditions for potential employees, and by the education sector through academic and certificate programs, more effective STEM advising suggesting pathways to a cybersecurity career, and a variety of cybersecurity-related events, such as workshops, conferences, and competitions. Each of these ways to increase recruitment and retainment within cybersecurity are targeted toward resolving the most serious obstacle to students not choosing or abandoning a career in the field – the loss of interest. The latter is typically generated by various issues, including financial challenges, lack of time, difficulties with successfully passing STEM courses, and general feeling of not belonging to the field (Flinders, 2019; Jethwani et al., 2017; Kennedy et al., 2017).

There is a growing body of literature suggesting a potential solution to some of these challenges – cybersecurity competitions (Balon & Baggili, 2023; Triplett, 2023; Weitzl-Harms et al., 2023).

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While the implementation of the idea needs to be enhanced further so that such events become more inclusive, more beneficial and more appealing to participants, the concept of cybersecurity competitions has proven its value, as various studies over the years describe (Bashir et al., 2017; Gavas et al., 2012; Manson et al., 2015; Mirkovic et al., 2015; Thomas et al., 2019). In order for participants to be well-prepared for these events, advisors also have an important role to play. As both teachers/professors and students work together in symbiosis to compete for the top places in competitions, it is important to monitor the motivations of both sides for participating and their experiences. Based on these insights then, scholars should suggest how the cybersecurity ecosystem itself can contribute to support further the relationship between professors/teachers, serving as mentors, on the one hand, and mentees, on the other, so that they have more successful collaborations.

Pursuing these goals, the current study assesses the extent to which educators and students' views on cybersecurity competitions overlap and differ and recommends ways in which the benefits for both sides can increase, as they continue to work together to close the cybersecurity skills gap. Furthermore, the findings from our study can be used for a formal training designed for faculty members who will serve as mentors – a mostly missing element in the entire STEM education system for which the literature is warning.

BACKGROUND

Importance of STEM-Mentoring and Related Challenges. In a system in which recommendation letters and networking opportunities, created by mentors are critical for the employment chances of students, the significance of building an effective and beneficial relationship between both sides is evident (Hund et al., 2018). At the same time, Hund, and colleagues (2018) emphasize that faculty members are promoted based on funding, research, and publications, which leaves little to no development of mentoring skills and monitoring of their mentoring success, as this is mostly a voluntary activity. In a survey they conducted, there is convincing evidence for the need for more faculty training with a focus on “patience, honesty, listening, and communication”, as these are among the most important qualities mentioned among respondents for the mentoring relationship (Hund et al., 2018, p. 9965). The need for a beneficial mentoring relationship becomes even more apparent when results from studies exploring such mentorship relationships are considered. One of them, conducted by Howell and colleagues (2020), shows some disturbing tendencies. In particular, their qualitative case study demonstrates that STEM doctoral mentoring is a no-feedback system based on inequality that is implicitly or explicitly biased in various ways – in terms of race, gender, and age. Moreover, the same study exposes “lack of responsiveness to student needs, and relational tensions” (Howell et al., 2020, p. 1). Evidence also exists that women and minorities are much more likely to suffer from imposter syndrome than their peers (Hinton Jr et al., 2020). This puts these minority groups at risk of being further marginalized. A study by Milkman, Modupe, and Chugh (2015) suggests that mentors are also more responsive to requests for mentorships coming from white male students and minority ones may not even seek mentorship because of the aforementioned imposter syndrome. According to Mondisa, Packard and Montgomery (2021), a large-scale solution to some of these concerns could be “evidence-based, sustainable mentor training for faculty and staff” but national networks are “not necessarily positioned for the kind of integration into departments and universities that will fundamentally shift the quality of mentoring at scale” (p. 11).

Strategies for Mentoring of STEM students. While the overall challenges of STEM mentoring are well-described in the literature, some special attention needs to be paid to strategies focusing on successful mentorship of underrepresented groups in STEM, which are scarce. However, the literature underscores some techniques that have proven themselves particularly successful. For instance, a study conducted by Kendricks and colleagues (2013) in a historically black college/university (HBCU) suggests that building a deeper, more meaningful relationship between mentor and mentee substantially increases student success. Chelberg and Bosman (2019) focus on the

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