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# Mentoring Cybersecurity Students in Online Degree Programs

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**Abstract**—This paper examines the design, implementation, and continuous improvement of a successful mentoring program integrated into cybersecurity capstone courses at Kennesaw State University, aimed at bridging the gap between academic learning and real-world experience. Faced with a need to implement experiential outcomes for cybersecurity graduates, the university introduced a structured mentoring initiative involving industry executives and technical leads to enhance students' professional development, networking opportunities, and practical skills. The program's structured approach to integrating industry mentorship has contributed to enhanced student engagement and provided valuable experiential learning opportunities. A continuous improvement process, anchored by after-action reviews at the end of each semester, allows the program to evolve in response to participant feedback, ensuring alignment with educational goals and addressing diversity, equity, and inclusion (DEI) challenges in the field. The paper concludes that this mentoring initiative offers students the opportunity to improve outcomes and underscores the importance of integrating experiential learning opportunities within academic curricula. Recommendations for institutions adopting similar programs include prioritizing mentor selection and training, implementing continuous feedback loops, and emphasizing mentor commitment to maximize student benefits.

**Keywords**—*Cybersecurity education, mentoring programs, experiential learning, professional development, diversity in computing, academic curriculum, student outcomes*

## I. INTRODUCTION

The increasing deficit of cybersecurity graduates in the United States has prompted educational institutions to explore innovative approaches to better prepare students for the workforce. One such approach is the introduction of mentoring programs, which have been shown to enhance academic performance, improve degree completion rates, and increase professional success post-graduation [4, 11]. The literature highlights the importance of mentoring in providing students with guidance, network-building opportunities, and valuable industry insights [15]. Additionally, mentoring

programs address DEI challenges in computing-related courses by increasing interest among underrepresented groups [14]. Successful mentoring relationships are characterized by effective communication, emotional stability, and a shared commitment to achieving mutual goals [1]. However, the success of these programs also depends on avoiding negative traits, such as dependence or underachievement, which can hinder the mentor-mentee relationship. This paper discusses the design, implementation, and continuous improvement of a mentoring initiative at Kennesaw State University (the University), aimed at bridging the gap between academic learning and real-world experience for cybersecurity students.

## II. LITERATURE REVIEW

### A. *Justifying a Mentoring Activity*

A deficit exists in cybersecurity graduates from United States universities [8]. A proposed aid to this problem is introducing a graduate mentoring program [3, 6, 18]. Numerous benefits stem from presenting a quality graduate mentoring program to a university. These include improvements to performance in their classes, which lead to degree completion [16] and increased success in their professional endeavors post-graduation. Having a trusted, knowledgeable professional in their field provides students with a vital vector to reach out for help and advice, both with the subjects of their courses and in terms of their path in their degree program and future careers, in the form of valuable network building. Waldron states, "As active participants in the profession, faculty can introduce their mentees to other professionals and provide valuable advice. This can help students develop networks, identify collaborators, understand funding opportunities (e.g., for research or travel to conferences), and develop skills to discuss their research" [16].

Structured mentoring models emphasize the role of comprehensive support systems in enhancing cybersecurity education outcomes. This aligns with existing research indicating the positive impact of mentoring on academic and professional success [17]. Beyond helping increase general interest and success in the program, successful mentoring

helps with the critical task of increasing DEI. DEI is an area lacking in computing-related courses, and peer mentoring specifically “has been shown to increase the interest of various levels of students, particularly diverse groups” [8, 12].

#### B. Positive Traits in Mentoring Projects

A successful mentoring program hinges on certain positive character qualities on both sides of the mentoring relationship. A good mentor exhibits positive communication with their mentees, a supportive, collaborative attitude, and a commonality of interests. The mentor should be able to manage and resolve conflicts effectively [2]. Reportedly, a good mentor is generally one selected by the student. Almond et al. state, “Individually chosen, compared with department chosen, mentorships are likely to lead to higher rates of successful mentorships if they are based on common interests and respect” [2]. In a successful mentoring relationship, both sides have requirements that they must withhold. The ideal student mentee should be emotionally mature to maintain a positive relationship with their mentor and meet their requirements and goals. “In general, mentors are attracted to students with high emotional stability and are subsequently more likely to invest in mentorships with stable graduate students” [7].

#### C. Negative Traits in Mentoring Projects

In addition to desirable traits in mentor and mentee, negative traits may lead to turbulence in the relationship and cause it to fail. Both parties must have their emotional needs met to achieve the effects of success mentioned above. Suppose a mentee feels their mentor does not meet their emotional and educational requirements. In that case, they may lose faith and respect in the mentor’s ability to aid them in their academic journey. Likewise, if a mentee displays certain negative qualities, the mentor may lose the drive to aid them, believing them to be a lost cause and losing their own desire to relate to and help the students in need.

Negative mentee qualities include dependence, narcissism, detachment, and such behavioral patterns as procrastination and underachievement. Huwe and Johnson state, “[Mentee] protégés who consistently underachieve stand little or no chance of garnering the attention and support of excellent mentors. Graduate protégés who are excessively dependent and emotionally needy are likely to alienate faculty mentors” [7].

#### D. Design Goals from Literature

A good mentoring program should consist of numerous and diverse mentors. According to Johnson et al., “Having multiple mentors buffers the effects of an ineffective advisor match, lightens the load of primary mentors, and provides trainees diverse forms of social and career support across the arc of their training and early career phase” [9]. To help appeal to the DEI issue, there should be mentors who represent minority groups. Almond et al. state, “Women and minority graduate students are likely to have differing mentor experiences and expectations than white men” [2]. Having

diverse mentors is critical to addressing these differences. A comprehensive mentoring model is crucial in cybersecurity education to ensure that students receive consistent support across various stages of their academic journey [17]. This approach helps better prepare students for real-world challenges by integrating practical insights and professional guidance into their learning experience.

Mentor training contributes significantly to a successful program. “[Mentor professional development and training] ... can help equip faculty learn about necessary tools and approaches to high-quality mentoring” [16]. Likewise, it may benefit a university to offer training for the mentees themselves to maximize the success and benefits of their relationship. The “Mentoring Up” approach can “help empower graduate students to be active and equal participants in the mentoring relationship” [16]. This approach reportedly involves a mentee’s high degree of proactive engagement, helping the mentor and mentee achieve a mutually chosen purpose. Some educational institutions currently offer workshops that provide training to graduate students for this approach [16].

While much of the mentoring literature focuses on long-term faculty–student relationships, industry-led, short-term mentorships, as seen in capstone courses and internships, are perceived to be understudied in current literature even though conventional wisdom indicates they provide unique benefits such as immediate exposure to real-world challenges and practical problem-solving skills. This is a gap in the current body of knowledge and offers an opportunity for future research. This case study contributes to this emerging area.

### III. EXPERIMENTING AT KENNESAW STATE UNIVERSITY

An instructor at Kennesaw State University, a Center of Academic Excellence in Cyber Defense Education (CAE-CDE), determined that mentoring would be of significant benefit to students in the University’s online cybersecurity programs, specifically the capstone courses in the Bachelor and Master Cybersecurity programs.

The cybersecurity capstone course is designed as an immersive, project-based learning experience. Students work in teams to address a simulated engagement with a fictitious company facing realistic cybersecurity challenges. In this simulation, a case-based scenario requires students to:

- Conduct a Cybersecurity Assessment: Analyze the company’s current cybersecurity posture, identify vulnerabilities, and propose remedial measures.
- Develop Strategic Recommendations: Formulate comprehensive strategies that encompass both technical solutions and managerial policies.
- Present a Consulting Report: Prepare and present a detailed report to a panel of industry experts, mirroring the dynamics of a real-world cybersecurity consulting engagement.

Mentors participate by guiding student teams through each stage of this process. Their involvement includes initial group introductions, individualized sessions to address specific student concerns, periodic group meetings to provide project feedback, and a final after-action review where both students and mentors reflect on the outcomes. This structure not only simulates the real-world consulting process but also integrates professional insights into academic learning.

#### *A. Objectives and Design Goals*

The idea originated from conversations with administrators and peers who emphasized incorporating external projects as experiential components for capstone students. However, as the challenge of identifying and managing hundreds of external projects each year became apparent, the concept of using case-based simulations, enhanced by the involvement of industry executives, was introduced. This approach offered a more manageable and impactful alternative. Consequently, the decision was made to pilot the integration of industry executive-level mentors into the graduate capstone experience, providing students with valuable real-world insights while maintaining the program's quality, rigor, and feasibility.

The project was initially designed to connect experienced senior executives in the Cybersecurity industry with students enrolled in a master's-level cybersecurity degree program. This program offers two distinct capstone tracks: one with a technical focus and the other with a managerial emphasis. The experiment specifically targeted the managerial capstone, concentrating on Governance, Policy, and Operational Implementation. The idea was for executives to engage with small teams of students as they participated in a simulated consulting exercise to improve cybersecurity practices within a fictional organization. This concept evolved from a well-established speaker series that previously brought executives and technical experts to campus for formal presentations, now reimagined as a more interactive and hands-on learning experience.

The primary objective of this project was to facilitate meaningful interactions between experienced executives and students nearing graduation. By engaging with these seasoned professionals, students gained valuable insights into the industry, helping them better understand the challenges and opportunities they might encounter in their careers. This exchange of perspectives aimed to enhance the student's knowledge and improve their professional development by providing guidance on career paths, skill enhancement, and workforce expectations. Additionally, these interactions were designed to broaden the students' networking horizons, connecting them with professionals who could serve as mentors or potential contacts in their future endeavors. Overall, the project sought to bridge the gap between academic learning and real-world experience, ensuring students were better prepared to transition into the workforce.

After several semesters of successful engagement between CISO-level executives and graduate students, the concept was expanded to include a second tier for undergraduate students. This new initiative invited Technical Leads and first-level managers from industry, government, and non-profit organizations to mentor students in the undergraduate cybersecurity capstone course. The course maintained the simulated engagement with a case-based company but with a broader focus that included technical skills, managerial competencies, and critical aspects of workplace readiness. This expansion aimed to provide undergraduates with the same well-rounded preparation for their future careers, blending hands-on technical learning with the practical skills needed to thrive professionally.

Currently, both classes benefit from a high level of engagement from industry executives, managers, and technical leads across the United States. Early feedback from students suggests that they find the mentoring experience to be highly valuable in contributing to the success of the courses. Based on this positive response, the University plans to continue and expand this mentoring initiative to other upper-level graduate and undergraduate courses in Cybersecurity and other STEM programs.

#### *B. Implementing and Operating the Project*

The process began by reaching out for assistance. Utilizing a mailing list developed over several years to support the Cybersecurity Programs Professional Speaker Series, which included approximately 250 industry contacts and a LinkedIn post, the capstone instructors successfully identified a group of potential graduate-level mentors. From the numerous volunteers who responded, each candidate was carefully screened for suitability based on their employment background. Based on research on mentoring [10], the desired traits of a mentor include strong communication skills, empathy, expertise in the relevant field, accessibility, and a genuine interest in the mentee's development.

After a thorough evaluation, an initial cohort of 10 mentors were selected and invited to participate in the program. From the outset, it was acknowledged that mentors might need to withdraw from their engagement with little or no advance notice. To mitigate the impact of such changes, it was decided to assign multiple mentors to the student groups. Initially, three groups were assigned two mentors each, while the remaining groups were assigned one mentor. As the number of volunteers increased, the current practice evolved to assign multiple mentors to each group. Since the program's inception, at least two mentors have withdrawn from each course every semester. By assigning numerous mentors to groups, the program has minimized the disruption caused by mentor withdrawals. In cases where a student team has all assigned mentors, the instructor can pull a mentor from another team without excess disruption. These mentors are familiar with the course and can seamlessly transition to support the new team, ensuring minimal disruption to the student learning experience.

Training was identified as a crucial component of this experiment [16]. The structured engagement plan and mentor training processes align with the best practices [17]. This model emphasizes the importance of well-prepared mentors and structured interactions to maximize student benefits. A comprehensive orientation session was conducted from the initial introduction of mentors in the graduate capstone course in Spring 2023. During this session, mentors received detailed written documentation outlining the course's learning objectives, providing an overview of critical assignments, and clarifying their engagement levels. It also offered best practices in mentoring and student interaction to prepare the mentors for their student engagement. This preparation ensured that mentors were well-equipped to support students effectively and aligned with the course's educational goals.

During the initial meeting, mentors were asked to follow a structured engagement plan throughout the semester. In weeks 1 and 2 of the semester, they conduct a group welcome and introduction meeting, lasting approximately 15 minutes. During weeks 3 and 4, mentors hold individual meetings with each student, dedicating 30 minutes per student, with the option to meet one or two times, depending on their availability. From weeks 4 through 14, mentors provide group project advice, with at least two meetings lasting 30 minutes each, though the duration and number of these sessions could be adjusted at the mentor's discretion. In the final weeks, mentors facilitate a group after-action review (AAR or "Hot Wash") session, lasting 30 minutes, to reflect on the project and overall experience. Additionally, mentors participate in an all-mentor AAR session after the semester ends, which lasts 30 minutes.

As a result of incorporating the mentoring experiment into the course, five additional assignments were introduced to engage students further. The first assignment required each group to produce a memorandum documenting the initial meeting with their mentors. Subsequently, each student was tasked with preparing an individual memorandum to record the details of their initial one-on-one meeting with the mentors. The following two assignments focused on documenting group meetings with the mentors, specifically those where project advice was sought for course-related tasks. The final assignment involved conducting a group AAR meeting, which will be documented in a memorandum. These assignments were designed to enhance student's learning experience by encouraging reflection and thorough documentation of their interactions with industry professionals.

### C. *Integrating Continuous Improvement*

From the outset, it was established that each semester would conclude with after-action reviews involving the student cohorts and their mentors and a collective review with all mentors. These reviews were designed to provide timely and valuable feedback from all participants, allowing for a thorough evaluation of the mentorship program and its alignment with course objectives. The insights gained from these reviews enable instructors to adjust the training

materials and mentorship assignments, ensuring that the program effectively meets its intended outcomes. By systematically incorporating this feedback loop at the end of each semester, the course can remain responsive to the evolving needs of the program, students, and mentors, enhancing the overall quality and relevance of the mentorship experience. This structured approach ensures continuous improvement and the sustained effectiveness of the mentorship program within the academic curriculum.

## IV. LIMITATIONS AND CHALLENGES

While the mentoring program has demonstrated significant benefits, several limitations and unexpected challenges have also emerged. For example, despite careful planning, some mentors exhibited sporadic engagement due to conflicting professional obligations. This inconsistency sometimes led to scheduling conflicts and gaps in the expected level of support for certain student groups. Additionally, not all student teams were able to fully leverage the experiential learning opportunity as some found the balance between academic requirements and the simulated consulting exercise challenging. These issues underscore the need for clearer expectations and enhanced coordination between mentors and students.

While the mentoring program has provided valuable experiential learning opportunities the current evaluation relies predominantly on qualitative feedback, and there is a notable absence of comprehensive quantitative data—such as comparisons of capstone project scores, job placement rates, or long-term career tracking—that could more robustly measure the program's impact. Additionally, the intervention has not been compared systematically with other experiential learning approaches, like internships or externships, leaving its relative efficacy somewhat uncertain. Moreover, although the program touches on diversity, equity, and inclusion, there is insufficient exploration of how these principles are specifically addressed in mentor recruitment and engagement. Future iterations of the program will incorporate more rigorous pre- and post-intervention surveys and longitudinal studies to better assess outcomes and to address these gaps.

## V. CONCLUSION AND RECOMMENDATIONS

In conclusion, integrating a mentoring program into the cybersecurity capstone courses at the University has proven to be a valuable enhancement to the student's educational experience. The structured involvement of industry executives and technical leads has provided students with real-world insights, professional development opportunities, and expanded networking horizons, all critical for their transition from academia to the workforce. Careful design and oversight of the mentoring program, including assigning multiple mentors and implementing a comprehensive engagement plan, has ensured the program remains flexible and resilient despite potential challenges, such as mentor withdrawals.

Moreover, the continuous improvement process, anchored by after-action reviews conducted at the end of each semester, has been instrumental in maintaining the program's alignment with its educational goals. These reviews have allowed for timely adjustments to the mentorship and course materials, ensuring that the program evolves in response to participant feedback. As a result, the mentorship initiative not only addresses the immediate needs of students but also contributes to the broader objectives of enhancing diversity and inclusion within the cybersecurity field. The success of this program highlights the importance of integrating experiential learning opportunities within academic curricula and underscores the potential for mentorship to impact student outcomes significantly.

Mentors add much to student engagement in the course, and some mentors were not as well engaged as hoped. The following comments are representative of those made by students in the final after-action review:

#### A. Selected positive feedback

- “[Our mentor] was great about spending time to both discuss the projects/assignments and the personal/career growth/goals of each group member.”
- “[Our mentor] expressed interest in the student's progress within the program, inquired about future goals, and offered to assist students by reviewing class assignments and giving feedback to ensure students complete class assignments successfully if help is needed.
- “[Our mentor] provided good ideas to help on assignments. He also provided good information on how to transition to the security field.”
- I really enjoyed speaking with “[Our mentor]. I hope to continue our professional relationship after this class ends.

#### B. Selected negative feedback

- “[Our mentor's] overall contribution was minimal. He attended a few meetings but never really added much to the discussions. In fairness, though, I never relied on him for help.”
- “[Our mentor's] attendance at mentor meetings was sporadic.”
- “[Our mentor's] overall contribution to our group's mentorship experience was non-existent due to his lack of presence during the semester. This was a significant disappointment for our team, as we missed the valuable knowledge and mentorship that would have supported our academic and professional journey.”

For future iterations, a survey of students will be expanded to assess the impact of the mentoring program. A mixed-method evaluation—combining qualitative feedback with quantitative surveys—will be employed to collect data from

student participants. Based on that feedback, additional insight into potential improvements will be identified. Additionally, a mid-term feedback process will be considered to allow the instructor to identify sub-standard performance by the mentors or the mentees.

#### C. Recommendations

To successfully adopt a mentoring program like the one implemented at the University, institutions should prioritize carefully selecting and training mentors. Choosing mentors who are experienced and knowledgeable in their fields and committed to actively engaging with students throughout the program is crucial. Providing mentors with comprehensive training that outlines the course objectives, expectations, and best practices for mentorship can help ensure they are well-prepared to support students effectively. Institutions should also consider assigning multiple mentors to each student group to minimize the disruption caused by potential mentor withdrawals and to provide students with a broader range of perspectives and expertise.

Additionally, institutions should implement a continuous improvement process that includes regular after-action reviews at the end of each semester. These reviews should involve both students and mentors and be used to gather feedback on the effectiveness of the mentoring program. By systematically incorporating this feedback, institutions can adjust the mentorship structure, course materials, and engagement strategies. This approach helps maintain the alignment of the program with its educational goals and enhances the overall quality of the mentorship experience, ensuring it remains relevant and impactful for students. Finally, institutions should emphasize the importance of mentor commitment and follow through on student feedback to address any issues related to mentor engagement, thereby maximizing the program's benefits for student's academic and professional development.

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