Full Paper: The impact of the ACCESS program on recruiting cybersecurity students and fostering their academic success and career prospects

1. Introduction

Cybersecurity is crucial in protecting individuals, businesses, and critical infrastructure from malicious cyberattacks that can lead to severe financial losses and operational disruptions. Securing key sectors such as healthcare, energy, and government systems is essential for national security. However, a global shortage of qualified cybersecurity professionals persists, with nearly 500,000 job openings in the U.S. [1]. As reliance on technology grows and cyber threats become more complex, the demand for skilled cybersecurity professionals is projected to increase by 33% from 2023 to 2033, far outpacing the average growth for all occupations [2].

To address the workforce gap, West Virginia University (WVU) launched a B.S. in Cybersecurity and an Area of Emphasis (AoE) in Cybersecurity for other B.S. majors in 2018. The B.S. program earned ABET accreditation in 2022 and is designated by the NSA as a National Center of Academic Excellence in Cyber Defense Education (CAE-CD). Aligned with this mission, the NSF S-STEM funded project "Attracting and Cultivating Cybersecurity Experts and Scholars through Scholarships" (ACCESS) aims to increase the annual enrollment in WVU's cybersecurity programs and support student success and career readiness. ACESS incorporates several co-curricular activities, including mentoring, student organization involvement, technical and career development seminars, undergraduate research, internships, and social events.

Student recruitment remains a significant challenge for many academic programs [3],[4]. Both traditional approaches (e.g., high school visits, admissions collaboration) and non-traditional methods (e.g., outreach to minority-focused student groups [5]) can be effective. Enhancing diversity also requires addressing barriers such as limited access, financial constraints, and low engineering self-efficacy [4]. Factors influencing college choice, such as socioeconomic status, academic performance, personal aspirations, and external influences like family and institutional communication [6], may similarly impact students' major selection. Effective recruitment emphasizes personalized outreach and career-focused messaging that highlights job stability and long-term opportunities [7],[8]. Incorporating multimedia content, such as brief instructional and testimonial videos, can further strengthen engagement with prospective students [9],[10].

Mentoring supports the development of essential life skills - such as communication, networking, and professionalism - while boosting confidence and encouraging persistence in academic and career paths [11]. Participation in subject-based organizations and competitions enhances student satisfaction, campus engagement, academic motivation, and commitment to future careers [12]. Social and professional events with peers, faculty, and industry professionals foster meaningful connections and promote skills like discipline, self-esteem, ethical behavior [12], and resilience [13]. Undergraduate research deepens understanding of academic content, offers mentorship, and strengthens ties to the chosen field. Undergraduate research experiences foster a sense of belonging and reinforce academic commitment [14],[15]. Tinto's model of social integration suggests such connections improve student retention and graduation rates [16].

This paper outlines the ACCESS program's goals and approach, provides a five-year overview of recruitment, scholarship, and enrollment trends, details co-curricular activities supporting student success and career development, and concludes with scholars' feedback on the program's impact on their academic and professional growth.

2. Project Goals, Objectives, and Methodology for Evaluation

Soon after establishing the new B.S. and AoE in Cybersecurity, the ACCESS team proposal was funded by the NSF S-STEM program. ACCESS's goal is to increase the number of undergraduate students with demonstrated financial need who complete B.S. degree in the cybersecurity field. The ACCESS program has the following objectives: (1) increase the annual enrollment of students in the Cybersecurity B.S. major and AoE at WVU; (2) enhance the co-curricular activities and student support services; (3) strengthen partnerships with employers from the public and private sector; and (4) investigate the impact of the ACCESS activities on students' success.

The ACCESS program includes several co-curricular elements, such as social events, technical and career development seminars, mentoring, participation in cybersecurity-related student organizations, support for undergraduate research, and summer internships. STEM education literature shows that social integration and student engagement foster self-esteem [12], sense of belonging [13], self-efficacy [17], and professional identity [12], [13], [14]. Self-efficacy [17] and professional identity [14], [15] are key to academic success and retention. These traits should be developed during the first year and cultivated throughout college and into students' careers. Near-peer mentoring supports this development by providing a safe, supportive space for students to explore their identities, build self-belief, and commit to career and life goals, further enhancing retention [18]. Many ACCESS activities that support recruitment and retention also help first-year students explore, grow interest in, and become excited about cybersecurity. Targeted seminars explaining the cybersecurity field and the benefits of ACCESS, professional and technical seminars open to all students, and natural mentoring among peers in student organizations and competitions, all help first-year students learn about the cybersecurity major and career options and become inspired to pursue them early in their college journey.

The impact of ACCESS activities on scholars' academic success and career prospects was investigated by the joint effort of the research and evaluation teams. Each spring, data about ACCESS scholars' experiences were collected via anonymous surveys administered in four computer science and cybersecurity courses at varying academic levels, and through Zoom-based focus group interviews conducted by the University of Washington evaluation team. The data were analyzed using descriptive statistics and qualitative methods. The evaluation team provided researchers with summarized qualitative findings, including illustrative student comments. Results were reported in research publications and annual reports to the NSF.

3. Results and Discussion

Results of the ACCESS recruitment efforts, activities that support students' academic success and career prospects, and the evaluation of the benefits of the ACCESS's activities are presented in this section.

3.1. Recruitment activities and ACCESS scholarship awards

Over five years (2020 – 2025), 96 annual ACCESS scholarships have been awarded to 63 unique students in five cohorts. The successful selection of ACCESS scholars was due to a wide variety of recruitment efforts to reach students at different levels, from high school students and incoming freshmen to current WVU students.

The outreach activities for high school students included presentations given by project team members, reaching students at high schools in the WVU area. Furthermore, WVU recruiters who focus on K-12 schools were provided with information about the scholarship. ACCESS scholars were also asked to share the scholarship information with their high school teachers, administrators, WVU peers, and other interested individuals. Finally, ACCESS scholarship information and application instructions were emailed to prospective and admitted students, and the application process was integrated into the Statler College scholarship application process.

To support undecided first-year engineering students in the Statler College, the ACCESS team conducted in-person presentations and asked instructors of freshman engineering courses to announce the ACCESS scholarship in their classes. Recruitment efforts also targeted current WVU students, both freshmen and upper-level, through regular posts in the Statler College ENews, in-person outreach to twelve large undergraduate classes in the Lane Department of Computer Science and Electrical Engineering (Lane Department), and targeted communications sent to various professional societies, honor societies, and student organizations across campus.

The breakdown of the awarded ACCESS scholarships per cohort, i.e., Academic Year (AY) is given in Table 1. As shown in Table 1, the outreach activities were successful in recruiting incoming freshmen. Thus, over the five cohorts, 35% of the new scholars were recruited while they were still in high school, which demonstrates the value of the ACCESS scholarship for recruiting talented incoming freshmen who specialize in cybersecurity at the WVU.

Table 1. The breakdown of the ACCESS scholarships per cohort

Cohort (AY)	High School	% High School	College	% College	Total Awarded
Cohort 1 (2020/21)	0	0%	9	100%	9
Cohort 2 (2021/22)	6	60%	4	40%	10
Cohort 3 (2022/23)	3	23%	10	77%	13
Cohort 4 (2023/24)	8	47%	9	53%	17
Cohort 5 (2024/25)	5	36%	9	64%	14
Total	22	35%	41	65%	63

The ACCESS program has a very high retention rate, with 83% of scholars (52 out of 63) receiving annual scholarship renewals. Of 11 students whose scholarships were not renewed,

two changed their major and one left the university. The remaining eight either graduated or are still enrolled but did not meet at least one renewal criterion (i.e., two graduated without completing the AoE, one took one-year personal leave, and five did not meet the GPA requirement). As detailed in section 3.2, ACCESS co-curricular professional development and student engagement elements played key roles in supporting retention and students' success.

The ACCESS program has also achieved its objective to increase the annual enrollment of students in B.S. and AoE in Cybersecurity and thus contributed to the success of these programs. Figure 1 depicts the enrollment trend over the years from the start of the ACCESS.

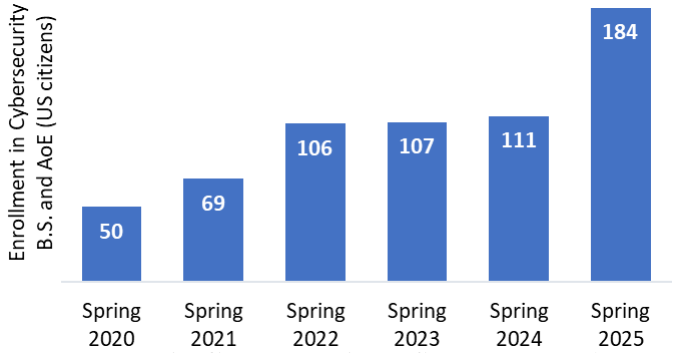

Figure 1. Enrollment in Cybersecurity B.S. degree and AoE at WVU

As shown in Figure 1, enrollment has grown 268%, from 50 U.S. citizen students (an eligibility requirement) in Spring 2020 to 184 in Spring 2025, significantly surpassing the national five-year cybersecurity program growth rate of 173% (22.5% annually) [19]. To date, 26 ACCESS scholars have graduated. Of these, 22 started full-time jobs in the cybersecurity field and four enrolled in graduate studies.

3.2. ACCESS activities that support students' academic success and career prospects

To aid student success and career prospects, the ACCESS program developed and offered a range of co-curricular activities, including social events, mentoring, participation in the CyberWVU student organization, undergraduate research, technical and career development seminars, and summer internships.

Social events, such as the award ceremony and the spring "Get together," fostered community building. The **award ceremony,** held each fall, recognized the achievements of the newly awarded scholars, while informal spring gatherings brought together scholars, the PI, and co-PIs.

Each ACCESS scholar was assigned a **mentor** and required to meet with them at least once each semester. In Year 5, eight cybersecurity faculty members served as mentors. In addition, scholars received academic advising from college advisors to support their academic planning and degree progress.

ACCESS scholars were encouraged to actively participate in **CyberWVU**, a student organization focused on cybersecurity. CyberWVU members meet regularly, organize training sessions, and participate in cybersecurity competitions.

The program also promoted undergraduate research opportunities, both at WVU and other universities. Over five years, ACCESS scholars participated in paid, externally funded research at WVU and secured funded research positions at NASA, Carnegie Mellon University, Tennessee Tech, and the Indraprastha Institute of Information Technology in India.

The ACCESS program has strengthened existing partnerships and established new ones with many cybersecurity employers. Over ten semesters (Fall 2020–Spring 2025), the ACCESS team organized **24 seminars and panels** presented by cybersecurity experts from both the public and private sectors. These events, open to all WVU students, provided valuable technical insights and helped promote the ACCESS program and WVU's B.S. and AoE in Cybersecurity. ACCESS scholars noted that the informal discussions and networking opportunities after the events made them feel comfortable reaching out to speakers for guidance and career advice.

Furthermore, the ACCESS team collaborated with numerous employers to provide students with specific **internship** opportunities. Majority of ACCESS scholars had summer internship positions. Those without internships were primarily rising sophomores, for whom there are fewer internship opportunities.

3.3 Evaluation of the benefits from the ACCESS's activities

Scholars' feedback about ACCESS activities was overwhelmingly positive. As shown in Figure 2, which is based on Year 5 data, 100% of ACCESS scholars strongly or somewhat agreed that they gained knowledge about career opportunities, felt more confident about starting a career in cybersecurity, learned from cybersecurity professionals in the field, and were able to access helpful resources. Additionally, 92% of the scholars reported gaining hands-on cybersecurity experience, and 75% noted forming relationships with other cybersecurity students.

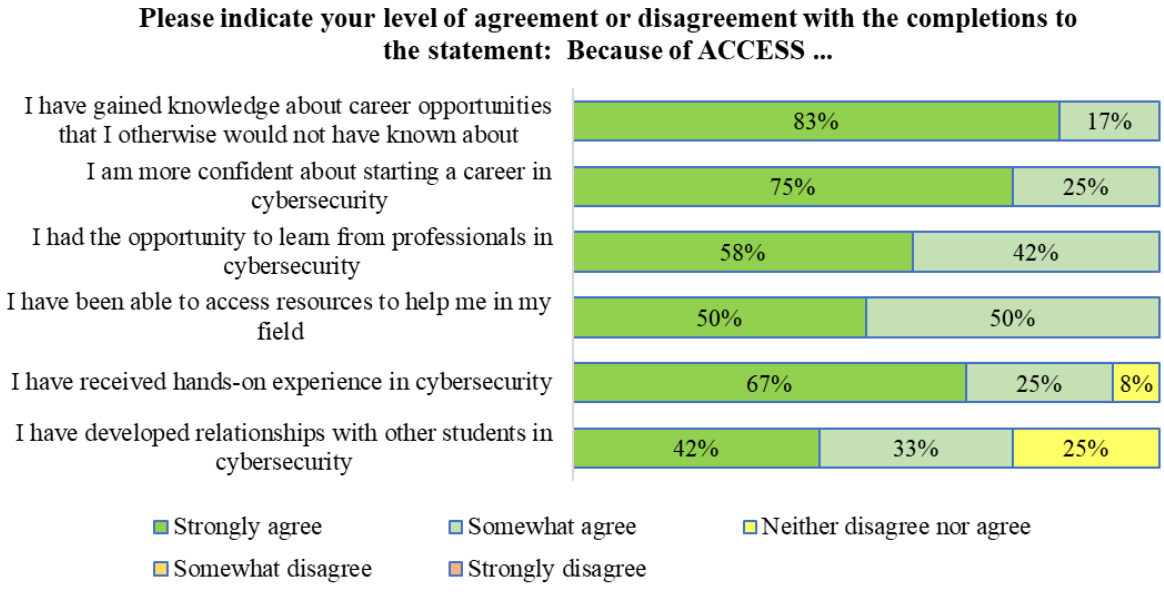

Figure 2. Students' feedback about benefits from the ACCESS activities (n=12)

Overall, all ACCESS students were satisfied with the ACCESS program, with 83% very likely and 17% somewhat likely to recommend it to their classmates.

3.4 Limitations

This study has several limitations. The small sample size of ACCESS scholars who completed the annual surveys precluded statistical analysis due to the limited statistical power. Additionally, since most program components (except for scholarships and faculty mentorship) were open to any interested students, it was not feasible to establish a true control group of students who were entirely unexposed to the intervention. The widespread accessibility of the ACCESS activities, while aligned with the program's inclusive goals, posed challenges for evaluating program impact and limited our ability to attribute observed outcomes solely to participation in the ACCESS program.

4. Conclusion

Over five years, the project awarded 96 annual scholarships to 63 students across five cohorts. Cybersecurity B.S. degree and AoE enrollment grew from 50 students in spring 2020 to 184 students in spring 2025. Notably, 35% of new ACCESS scholars were recruited in high school, highlighting the scholarship's role in attracting talented freshmen and increasing enrollment.

Scholars valued the opportunity to connect and network within the ACCESS community, including peers, mentors, guest speakers, and staff. Several scholars noted that ACCESS provided one of the few avenues to engage with upperclassmen, whose insights on courses, professors, and career opportunities were especially beneficial. Scholars also expressed strong appreciation for CyberWVU activities, highlighting their focus on practical skills valued by employers. Seminar presenters were seen as genuinely invested in students' career development and eager to share opportunities. As one scholar remarked "the seminars were really interesting and kind of expanded my thinking about cybersecurity."

ACCESS co-curricular professional development and engagement activities significantly contributed to high retention and academic success. As a result, 83% of scholars (52 of 63) had their scholarships renewed. Of the 11 who did not, eight either remain enrolled or graduated. To date, 26 scholars have graduated and secured full-time positions or entered graduate programs, reflecting the program's positive impact on academic and career outcomes. Overall, enrollment increased, retention and persistence improved, and scholars consistently recognized the value of ACCESS activities in supporting their academic and professional goals.

5. Acknowledgment

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