Utilizing Culturally Responsive Strategies to Inspire African American Female Participation in Cybersecurity

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Abstract

The number of African American females participating in cyber fields is significantly low. To increase African American female participation in cybersecurity, STEM education requires a new approach to student engagement. The most common approach to engaging more African American females in STEM is to provide students access to professional images or role models active in STEM; however, this is not enough. More race-centered strategies beyond role-modeling are needed to attract and retain African American females in STEM. Research studies show that integrating personal experiences and making cultural connections can help improve student participation in STEM from underrepresented populations. In this work, culturally responsive teaching strategies (CRT) are used to engage African American female middle school participants in a summer program.

In 2021, faculty in the Center for Cybersecurity Assurance and Policy (CAP) at Morgan State University (MSU) developed and implemented the GenCyber 'Females are Cyber Stars' (FACS) Summer Camp. This initiative targeted female African American students in Baltimore Public Middle Schools. A total of 39 girls participated in the virtual program during the summer of 2021, and 25 girls engaged in the in-person program during the summer of 2022. The goals of the program were to increase female students' interest in cybersecurity and provide exposure to the fundamentals of cybersecurity, exploitation of hardware and software vulnerabilities, and security of IoT (Internet of Things) devices in a smart home environment.

The FACS Summer Camp Program incorporated culturally responsive strategies to engage the participants in an inclusive and interactive setting. Incorporating culturally responsive strategies empowers students intellectually, socially, and emotionally by using cultural references to teach academic skills. When using this approach, instructional materials should include information relevant to the students' background, customs, and experiences and challenge students to think critically.

Participants were given pre- and post-program surveys to assess learning outcomes and examine the impact of using CRT. The results showed that the girls reported an increase in their knowledge and a gain in interest about cybersecurity and computing. This paper discusses the summer program and curriculum, culturally-responsive teaching strategies deployed, student learning outcomes, and perceptions of cultural responsiveness assessed in the Females are Cyber Stars summer programs.

Introduction

Meeting the future cybersecurity challenges requires the United States to utilize all of its available workforce talents. There is a shortage of nearly three million cybersecurity professionals and staff. Almost 60% of organizations report that they are at an extreme or moderate cyber risk due to the high staff shortage [1]. Although women are a significant resource pool, historically the technology industry has done a poor job recruiting women in cybersecurity and other tech areas [2]. To address this deficit, concerted efforts were made to recruit and retain females in the cybersecurity industry by providing educational, networking, and mentorship opportunities. As a result, women constitute about twenty-five percent of the male-dominated cybersecurity workforce [3]. Experts in the industry suggest companies can lessen the gender gap in the cybersecurity field by partnering with schools to educate girls, inspiring girls and women to

pursue technology courses, explicitly marketing career opportunities to women, and promoting women to high-level cybersecurity jobs to provide role models for these new workers. [2]

Women have earned about half of all bachelor's degrees, but the proportion of degrees awarded to women in computer science and engineering in 2016 is the lowest. [4] The $(ISC)^2$ Cybersecurity Workforce Study report notes that women working in cybersecurity currently account for about 24% of the workforce. [1] According to another ISC2 study on race and ethnicity, 26% of the cybersecurity workforce identified as a minority, of which 17% were female and 9% identified as African American. [5] These numbers show that the level of underrepresented minority female participation in cyber fields is still relatively low. To make an impact, female enrollment in engineering, computer science, and IT programs must increase considerably to ensure that the necessary graduates are ready to join the cyber workforce. Although there has been much discussion of and effort put into growing the numbers, the undergraduate female engineering and computer science enrollment remains much lower than desired at approximately 24% and 29% at a national level [4]. Considering underrepresented minorities, particularly African American, female enrollment in engineering, it is only 2.5%, and 6% in computer science [4].

Low participation in STEM is not unique to African American females; it also extends to other members of the race. When analyzing the problem of African Americans' low attainment in STEM, one major issue is the lack of access to educational institutions that prepare African Americans to successfully matriculate through a STEM program. Urban public schools are typically underfunded, which leads to deficits in instructional resources, staffing, and extracurricular activities (Century Foundation, 2020). These schools lack the necessary resources to prepare African American students to be successful in STEM, which requires tremendous resources. Darling-Hammond [6] states that "the educational system is one of the most inequitable in the industrialized world, and students routinely receive dramatically different learning opportunities based on their social status." Another issue is the way STEM is traditionally taught. Researchers and educators suggest redesigning the educational experience for African American STEM learners. Holly [7] recommends discussing the achievements of African Americans in the area of STEM, emphasizing social skills and teaching with socio-political awareness; Prime [8] proposes implementing a race-visible pedagogy; and Shockley, Burbanks, and LeNiles [9] advocate for the utilization of an African centered pedagogy. In other words, these researchers and educators recommend taking into account the racialized experiences of African American learners in American society in every aspect of their STEM education. That is, the choice of content, the instructional practices, the teacher/student interactions, the assessment practices are all designed in consideration of the experience of Blackness in contemporary American society.

A growing body of literature builds on the work of African American educators [10][11][12][13] to emphasize how centering the ideas, values, and customs of African American people can enrich STEM education [8][14][15]. The takeaways from these proven approaches are (a) the need to reframe the cause of difficulty for African American students learning STEM, (b) embedding cultural knowledge of African American people increases African American students' engagement and comprehension, and (c) African American cultural knowledge transforms conceptions of STEM knowledge and teacher practice. Adjapong & Emdin [16] and Brown's [17] work has shown that when African American students are given the opportunity to participate in the learning setting in a way that is natural to them, previously excluded students engage at a high level, demonstrating competence and enthusiasm.

One way for African American learners to participate in an inclusive, productive, and engaging classroom environment is for instructors to embed a Culturally Responsive-Sustaining (CR-S) framework. The Culturally Responsive framework proposes creating student-centered learning environments that affirm cultural identities; foster positive academic outcomes; develop students' abilities to connect across lines of difference; elevate historically marginalized voices; empower students as agents of social change; and contribute to individual student engagement, learning, growth, and achievement through the cultivation of

critical thinking [18]. Ladson-Billings introduced the term culturally relevant pedagogy over two decades ago based on her research on effective teachers of African American students. These studies concluded that educators who incorporated strategies that help students develop positive cultural and ethnic identities; recognize how to identify, comprehend, and analyze social inequities; and encourage students to achieve academically and positively impacted classroom performance [19]. Additional researchers expanded upon Ladson-Billings' research and later conceived the term culturally responsive teaching, which proposed utilizing ethnic backgrounds and experiences to increase academic engagement and performance [19]. Positive outcomes associated with implementing culturally responsive strategies included increased academic achievement, interest in school, and improved attendance [19].

The utility of culturally responsive teaching strategies has increased to offer tailored instruction and spark interest in STEM among African American youth. EdAnime Productions[1] offers a program called Conscious Ingenuity that uses African American history and culture to teach STEAM concepts to K – 8th grade students. B-360[2] is a nonprofit organization that uses dirt bike riding to teach K-12th grade students math and science. Students are also exposed to coding, 3D printing, robotics, and dirt bike construction and maintenance. Math Thru Music (MTM)[3] is an educational program that utilizes DJing, music, and a STEM curriculum to improve problem solving skills and mathematical ability. Gifted and Lit[4] is an educational program that utilizes animations and hip hop music to teach math, science, and language arts to K-12th grade students.

This paper details the culturally responsive teaching strategies (CRT) utilized for the GenCyber "Females are Cyber Stars" (FACS) Summer Camp to teach cybersecurity concepts to African American girls interested in STEM. A description of the lessons, instructional materials and additional strategies is provided. The participants completed pre- and post-program surveys for implementers to assess the impact of CRT. The survey questions and an analysis of the survey results are provided.

Program Description

Morgan State University (MSU) hosted a GenCyber "Females are Cyber Stars" (FACS) Summer Camp Program for African American female students who attend public middle schools in Baltimore. The goals of the program were to:

- Increase African American female students' interest in cybersecurity
- Utilize effective strategies to teach cybersecurity concepts to African American female students
- Impart best practices for safe online behavior
- Expose students to GenCyber Cybersecurity Concepts using IoT devices commonly found in the Smart home.

Target Population

Universities employ intervention programs to help increase African American female enrollment in computer science and engineering. Interventions that include mentoring, role modeling, and out-of-school enrichment programs such as summer camps are examples of ways to draw girls to STEM areas. Research shows that capturing more female student interest in cybersecurity requires student engagement during the middle school years [20]. The GenCyber FACS summer camp specifically targeted African American female students due to their low involvement in the STEM field. Female

[1] Website: EdAnime Productions (https://edanimeproductions.com)

[2] Website: About B-360 (https://b360baltimore.org/about-b360/)

[3] Website: 5Starr Enterprises (http://5starrenterprise.com/educational-services/)

[4] Website: Gifted and Lit Educational Program (https://giftedandlit.com/pages/who-is-gifted-lit)

minorities represent a potentially untapped resource for increasing and sustaining a diverse STEM workforce. It is imperative to create avenues to strengthen the mathematics and science skills of African American females, which can remain unrealized if not addressed before middle school [20].

Recruitment efforts were centered around partner schools within the Morgan Community Mile as well as schools with a working relationship with the Morgan State University School of Engineering due to the high African American population amongst the surrounding middle school population. We extended recruitment efforts to middle school programs in Baltimore County to help meet our participant numbers. Recommendations from local school administrators and community partners were also considered.

1. Marketing

Culturally relevant imagery was intentionally utilized on marketing materials for the GenCyber FACS Summer Camp. Camp announcements and web advertisements contained images of middle school-aged African American girls adorning clothing and hairstyles unique to the target demographic. Images of ethnically matched teachers and staff engaged in technology were used to promote a congenial environment for the participating youth. Studies have concluded that representation can increase student interest, engagement, and achievement [21].

Marketing efforts to the target population included:

- Mailing printed flyers to middle school principals in the Morgan Community Mile, with a focus on Baltimore City Public Schools
- Sending emails to middle school guidance counselors and technology teachers
- Posting information on the Center for Assurance and Policy (CAP) website with associated links on the Engineering, Computer Science, and Information Systems Department web pages
- Posting flyers and advertisements to the social media pages of the School of Engineering, Engineering Alumni Group, and community partners
- Distributing press releases from institutional university relations staff disseminated electronically.

Faculty and Student Facilitators

Ethnically matched engineering faculty members and student facilitators was an important aspect of the summer program. Faculty members were highly regarded members of the CAP Center housed on the campus of Morgan State University. Each faculty member possessed a four-year college and post-graduate degree in Electrical and Computer Engineering. Student facilitators were current graduate students working alongside CAP Center faculty members. Each student facilitator possessed a four-year college degree in Electrical and Computer Engineering. Student facilitator selection was based upon their level of knowledge in cyber concepts and their desire to work with young girls. The makeup of the team is noted below:

Program Director: Provided overall supervision of GenCyber camp including activity planning and implementation.

Program Coordinator: Facilitated camp marketing, recruitment, and registration; managed daily camp activities and program office.

Lead Instructor: Provided development of cyber course curriculum related to camp theme and oversaw course content delivery to participants.

Curriculum Developer: Provided K-12 pedagogical expertise in student assessment and a framework for curriculum and teaching practices.

Camp Instructor: Delivered course content to participants, conducted knowledge checks, and deployed exit tickets.

Student Facilitators: Assisted Instructor during lessons and hands-on activities, provided feedback to Program Coordinator and Instructor as needed, and served as role models to camp participants.

Program Implementation

The FACS summer program consisted of an engaging learning experience for African American female students ages 11 through 15. A total of thirty-nine (39) students participated in a half-day two-week virtual program during 2021 and twenty-five (25) students participated in a full-day one-week face-to-face program during 2022. General camp schedules are noted in Figure 1. Each session began with a "huddle" to build relationships within small groups and encourage positive social-emotional development. The sessions focused on building self-esteem, self-confidence, and fostering a positive self-image. After the huddle, students were given a technical lesson on one of the six cybersecurity concepts: *Confidentiality, Integrity, Availability, Defense in Depth, Think Like an Adversary, and Keep it Simple*. Students participated in a group activity following the lesson to increase their understanding of the concepts discussed during the session. At the close of each session, students completed formative assessments by providing reflections on concepts learned for the day.

VIRTUAL SCHEDULE

TIME	DAY 1	DAY 2	DAY 3	DAY 4	DAY 5
8:30 AM – 9:00 AM	Registration/Check-In	Morning Huddle with Mentors or Tech Talk w/ Cyber Professional	Morning Huddle with Mentors or Tech Talk w/ Cyber Professional	Morning Huddle with Mentors or Tech Talk w/ Cyber Professional	Morning Huddle with Mentors or Tech Talk w/ Cyber Professional
9:00 AM – 9:50 AM	Welcome & Orientation	Cyber Lesson	Cyber Lesson	Cyber Lesson	Field Trip
9:50 AM – 10:00 AM	BREAK	BREAK	BREAK	BREAK	
10:00 AM – 11:20 AM	Cyber Lesson	Hands-On Cyber Activity	Hands-On Cyber Activity	Hands-On Cyber Activity	
11:20 AM – 11:30 AM	BREAK	BREAK	BREAK	BREAK	
11:30 AM – 12:00 PM	Hands-On Cyber Activity	Reflections	Reflections	Reflections	Reflections

***Note: Activities were modified during the second week to include a post-camp survey, final student presentations and the closing ceremony.*

F2F SCHEDULE

TIME	DAY 1	DAY 2	DAY 3	DAY 4	DAY 5
9:00 AM – 9:10 AM	CHECK-IN & DAILY AFFIRMATION				
9:10 AM – 9:35 AM	Welcome & Program Expectations	Morning Huddle with Mentors	Morning Huddle with Mentors	Morning Huddle with Mentors	Morning Huddle with Mentors
9:35 AM - 9:50 AM	Pre-Survey	CYBER SPOTLIGHT: African American Women in STEM			Post-Survey
9:50 AM - 10:00 AM	BREAK				
10:00 AM – 11:00 AM	Cyber Lesson & Hands-on Activity	Cyber Lesson & Hands-on Activity	Cyber Lesson & Hands-on Activity	Cyber Lesson & Hands-on Activity	Cyber Lesson & Hands-on Activity
11:00 AM - 1:00 PM	CAMPUS TOUR & LUNCH				
1:00 PM - 1:40 PM	Cyber Lesson & Hands-on Activity	Cyber Lesson & Hands-on Activity	Cyber Lesson & Hands-on Activity	Cyber Lesson & Hands-on Activity	Cyber Lesson & Hands-on Activity
1:40 PM - 2:30 PM	Hands-on Activity	STEM Professional	STEM Professional	STEM Professional	Hands-on Activity
2:30 PM - 3:00 PM	Student Choice Activity & Class Dojo Reflections				CLOSING ACTIVITY

Fig. 1. GenCyber Females are Cyber Stars' Daily Schedules

Commented [1]: I added general schedules for both virtual and F2F programs.

The program was designed to provide middle school female students with active learning experiences under the guidance of graduate student facilitators and STEM faculty. In other words, our goal was to include an abundance of interactive activities and projects for participants to complete in small groups. The activities were related to everyday items students encounter in their homes to help with drawing connections between the concepts learned in the classroom and real-world contexts. Students routinely worked in groups to explore the Smart Home use-case to demonstrate mastery of the six cyber concepts by exploiting and defending a designated home automation device. Students participated in active cyber-related discussions with African American female engineering practitioners.

Program Curriculum

The curriculum framework for the GenCyber FACS Program was centered around curricula from Common Sense Media[5] and CYBER.ORG[6]. Common Sense Media provides free K-12 ready-to-teach lessons on digital citizenship and online safety. Most of the curriculum material had to be complemented with information from books, journals, and periodicals. Supplemental curriculum material included videos, animations, and cartoon avatars that illustrate the cultural images and social connections related to the demographics of the participants. All Common Sense Media lessons used within the FACS Summer Camp met standards for Common Core English Language Arts (ELA), American Association of School Librarians (AASL), the International Society for Technology in Education (ISTE), and Core SEL Competencies (CASEL). Common Sense Media curricula contain lesson plans, lesson slides, student handouts, assessments, and take-home resources for family engagement. CYBER.ORG's curricula were used within the FACS Summer Camp program to provide lessons focused on the six GenCyber Cyber Security Concepts. CYBER.ORG provided its curricula and allowed Morgan State cyber faculty access to a robust library of cyber-based curriculum and activities. CYBER.ORG has created cyber curricula targeted at middle and high school students. Curriculas from CYBER.ORG contain instructor teaching plans, hands-on learning activities, and PowerPoint slide presentations that cover GenCyber concepts. The FACS Summer Camp lead instructor utilized Common Sense Media and CYBER.ORG instructor lesson plans as a template for creating lesson plans regarding the GenCyber concepts, online safety, and cyber ethics. CYBER.ORG's curricula introduced students to foundational coding concepts through project-driven, hands-on modules and integrated the use of Micro:bit for student interaction with sensors.

As noted above, students learned about six cybersecurity concepts: Confidentiality, Integrity, Availability, Defense in Depth, Think Like an Adversary, and Keep it Simple. The six cybersecurity concepts and topics about online safety, cyber ethics, and digital ethics were reinforced in the curriculum activities, as shown in Table 1.

[5] Common Sense, https://www.commonsensemedia.org
[6] CYBER.ORG, https://cyber.org

Table I
Camp curriculum overview incorporating the GenCyber Concepts and additional related cyber topics

CATEGORY	TOPICS	EXAMPLE ACTIVITIES
C1: Defense in Depth	T1: IoT Network Security: What are the varying levels of security? How are firewalls, antivirus software, VPNs used to protect IoT network? T2: Passwords: How can passwords be used to secure information?	- Instructor Presentation - PBS game - 'How secure is my password?' activity
C2: Confidentiality	T1: Cryptology: What is cryptology? T2: Encryption: What is encryption? How can encryption be used to keep information protected?	- Instructor Presentation - Sending, sniffing and encrypting wireless packets using the Microbit - Sending, sniffing and encrypting wireless packets using the IoT device
C3: Availability	T1: Denial of Service: What are denial of service attacks? How can systems resist against these attacks so that use is uninterrupted?	- Instructor Presentation - Game 'UNO-DoS' - Implementing a DoS attack using the Micro-bit - Case Studies
C4: Integrity & Think Like an Adversary	T1: Understanding elements of information security T2: Identify different types of security threats and attacks such as hacking, a replay and brute force attack T3: Replay and Brute Force Attack: How can data be retrieved by unauthorized users? How does digital signatures and authentication protect against unauthorized use?	- Instructor Presentation - Google Hack - Video - Implementing a replay attack using the IoT device
C5: Summer Camp Final Project	T1: Secure Smart home with IoT devices: How can devices in the home be subject to security attacks? How can devices in the home be protected from security attacks?	- Student presentation of various rooms in a home with an IoT device.
C6: Cyber Ethics	T1: Ethical Use of Computer Technology: What is cyber Ethics? What is appropriate technology use? T2: Copyright: How to acquire online content legally and ethically?	- Instructor Presentation - Videos - Case Studies - Student Discussions (Think-Pair-Share)
C7: Online Safety	T1: Protecting Privacy T2: Creating Passwords T3: Cyberbullying T4: Phishing T5: Digital Citizenship	- Instructor Presentation - Complete IROC2's Cyber Safety Risk Assessment - Videos - Student Discussions (Think-Pair-Share)
C8:Digital Citizenship	T1: Digital Footprint T2: Social Media & Relationships T3: Talking Safely Online	- Video Case Studies - Student Discussions (Think-Pair-Share)

Students focused on learning about various cyber-attacks and countermeasures used to protect against cyber-attacks through encryption and password generation during the first two days of the program. Students utilized information gathered from the technical lessons and the hands-on activities and applied the knowledge they learned to initiate attacks and countermeasures on an IoT device each day of the program. Additionally, students participated in activities that helped them draw connections between the concepts learned in the classroom and real-world contexts.

The curriculum facilitated a learner-centered classroom because students were provided opportunities to engage with the academic content by participating in games, small groups, case studies, developing software code using Python, discussions, and presentations.

Classroom Management and Student Interaction

Culturally responsive strategies (CRS) were the bedrock of the FACS camp curriculum in terms of instruction, activities, classroom management, and teacher-student and facilitator-student interactions. The objective of utilizing culturally responsive strategies was to connect students' culture and life experiences to support comprehension and engagement.

One CRS was utilizing ethnically matched instructors, student facilitators, and professional speakers. This strategy has been proven to increase student interest, engagement, and achievement [21]. Another strategy was to incorporate an empowerment activity to address the social-emotional needs of African American girls. Each session began with activities that increased self-confidence and self-esteem. Studies indicate African American girls who participate in afterschool programs that promote pride in Black culture are more connected and involved in school [22]. Incorporating images of African Americans throughout the instructional materials was another strategy used within the FACS camp. African centered psychologists, such as Amos Wilson and Kobe Kambon, have noted the adverse effects of displaying nonrepresentative imagery to African American children. They assert that inundating African American children with positive self-imagery builds self-esteem, strengthens self-identity, and increases confidence [23][24]. Another CRS utilized was to incorporate the use of the students' own personal experiences. Lessons incorporated everyday items from the home that students could easily identify and relate. Because African Americans are communal, employing cooperative learning through hands-on activities requiring problem solving was another strategy used. Studies show that African American students strive in communal learning environments [25].

In 2021, Zoom was the selected video conferencing platform used to facilitate real-time aspects of the FACS camp curriculum. The communication software allowed for the creation of a virtual classroom wherein students received instruction, completed activities and participated in discussions. Zoom also afforded the instructor the ability to conduct small group sessions. Student facilitators assisted the instructor with daily monitoring of break-out rooms and chat features. All sessions were recorded and made available to participants upon request. In 2022, the camp was conducted in person rather than virtually.

In 2021 and 2022, the instructor used PearDeck to deploy each lesson (see Figure 2 for lesson structure). PearDeck is an interactive presentation program used to increase student engagement and monitor apprehension of instructional objectives. The instructor incorporated additional online instructional tools such as Google Slides and Class Dojo in each lesson. Google Slides is an online program used to create, modify and collaborate on presentations in real time. Class Dojo is an online platform that builds cohesive classroom communities and provides opportunities for teachers and student facilitators to give parents daily feedback about classroom performance. The presentation software allowed the instructor to incorporate

images relevant to the students' culture to teach technical skills. Visual components (video, bitmoji, emoji) used during instruction directly related to the students' background and life experiences. Students were provided opportunities to collaborate with peers, through the use of these instructional tools, by completing activities to address social-emotional development and evaluate the acquisition and application of learned concepts.

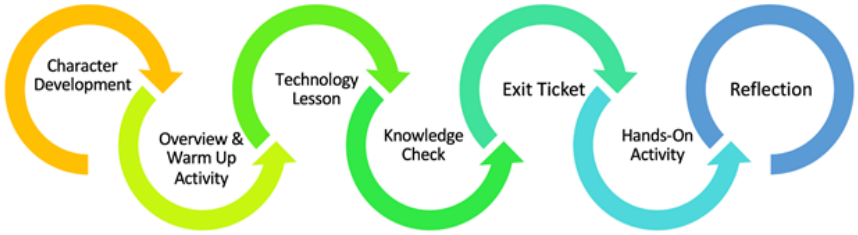

Fig. 2. GenCyber Females are Cyber Stars' Daily Schedule

Student Assessment

In a culturally responsive classroom, a key component is student assessment and feedback. The curriculum developer integrated proven teaching strategies to ensure the camp instructor allowed students to reflect, assess understanding of concepts at checkpoints, and obtain feedback. Formative and summative assessments were used throughout the program to assess student knowledge and comprehension. Examples of formative assessments incorporated in each lesson included low-stakes quizzes, student polls, and exit tickets. Participants also engaged in open-ended discussions with peers to help increase comprehension of learned concepts and encourage critical thinking.

At the end of the program, summative assessments given to participants included a cumulative activity and a final student project. An interactive learning tool was used to assess cybersecurity topics introduced throughout the camp. The final project required students to work collaboratively to explore the Smart Home use case to demonstrate their understanding of the six cybersecurity concepts noted above. Similar to the home illustrated in Figure 3a, the smart home included five different rooms (i.e., bedroom, living room, laundry room, kitchen, and garage). Each student team implemented cyberattacks and countermeasures associated with a specific IoT device specific to a home's room. The home IoT devices of interest included smart lighting, switch, thermostat, motion detector, and a garage door opener. Students accessed and utilized virtual machines to connect to the Raspberry Pi(s) portion of the isolated network in Figure 3b.

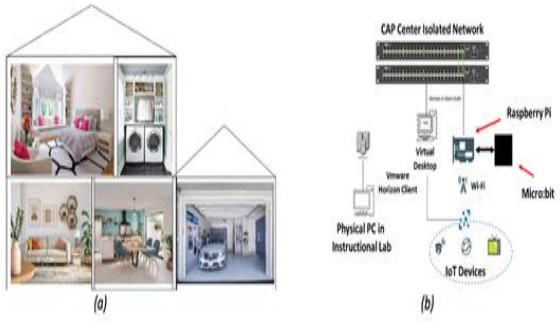

Fig. 3. Illustration of the (a) Smart Home Scenario and (b) the computer network to facilitate cyber-attacks and countermeasures using IoT devices

Finally, evaluation surveys were administered at the beginning and at the end of the camp sessions in both years. In terms of learning, 100% of the girls in 2021 and 78% of the girls in 2022 reported learning "a lot." Comparing their pre- to their post-camp responses, in 2021, they jumped from 10% knowing *a lot* about cybersecurity and computing before the program to 70% knowing *a lot* after it. In 2022, the jump was from 4% to 44% reporting knowing *a lot* about the topic. Most showed at least some gain in self-reported knowledge: 80% in 2021 and 87% in 2022.

In terms of engagement, 100% of the girls in 2021 and 57% of the girls in 2022 reported enjoying the program "a lot." Comparing their pre- to their post-camp responses, in 2021, 40% of the girls reported at least some gain in interest in the topic, and in 2022, 69% of the girls reported at least some gain in interest.In 2021, 40% of the girls reported being at least "somewhat likely" to seek out further engagement with cybersecurity and computing, whether by talking about it, looking for more information, pursuing further education in and out of school, and seeking information about jobs in these areas. In 2022, these figures ranged from 44% to 57% being at least "somewhat likely" to engage with cybersecurity and computing in these ways.

The program survey results showed more engagement and learning during the virtual program in 2021 than during the in-person program in 2022. In the fall of 2021, there was a challenging transition from virtual to in-person learning in the overall school system (i.e. standard K12 classes and out-of-school programs). Instructor observations suggested that the adjustment from virtual to in-person classes resulted in a more disruptive learning environment in which increased distractions may have inhibited the retention of new concepts. An increase in engagement and learning is expected this summer now that students have had more time to become reacclimated to in-person learning.

In 2022, specific items addressing CRTs were added to the evaluation survey. As shown in the table below, all or most of the girls agreed with all 15 items.

TABLE II
Responses to 2022 Evaluation Survey CRT Items

Culturally Responsive Teaching Practice	% who "agree" or "strongly agree"
The program instructors, staff, & administration understand & respect cultural differences.	100%
I feel that the instructors believe that all participants can learn & they make an effort to ensure that all participants do learn.	100%
I was given help when I didn't understand.	100%
My instructors speak about contributions that my culture has made to cybersecurity & computing.	100%
Diverse identities are represented in the lessons & activities.	96%
Participants are free to share concerns & pressing issues.	96%
I feel that instructors use words that I understand & relate to in order to teach lessons.	96%
It was inspiring to see women who looked like me in positions of power & influence.	92%
I feel that participants are treated fairly.	91%
It was motivating to see others who looked like me.	87%
I was recognized for my strengths.	84%
I feel that the instructors use creative ways to teach lessons.	83%
The personal development activities helped me to gain confidence & improved my self-esteem.	83%
My instructors use what I already know about cybersecurity & computing to help me understand new ideas.	82%
My instructors communicate with my parents about what I am learning.	73%

Future Work

The 2021 survey results demonstrate that the program can be effectively deployed in a virtual format. Therefore, in order to broaden access to the program, we plan to add a virtual component to engage African American girls beyond the in-person program in Baltimore. The program will be available via an online video conferencing platform. Lessons will be delivered via PearDeck and will allow for interaction between virtual and in-person students. Supplies would be delivered to the home of each virtual participant. A teaching assistant would be designated to assist the girls online with the hands-on activities.

Conclusion

This paper has provided an approach to implementing culturally responsive teaching strategies within a summer camp environment. A culturally responsive framework was utilized to promote learning, growth, and achievement amongst the African American female participants in the GenCyber FACS camp. Applied methods included the use of culturally relevant imagery on marketing and curriculum materials, daily engagement with ethnically matched faculty, student facilitators, and professional cyber speakers, the inclusion of social-emotional learning activities, and the incorporation of interactive activities to connect STEM to everyday life. These combined methods provided participants with an inclusive and engaging environment to further their learning and interest in STEM and cybersecurity, and were effective as attested by the results of the program surveys.

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