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Enhancing Learning Outcomes for African American STEM Learners Through the African-Centered STEM Education Model (Evaluation)

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African Americans have a rich history of contributing to Science, Technology, Engineering, and Mathematics (STEM). Bailey and Holly (2023) highlight that this legacy originates millions of years ago in Africa, evidenced by innovations such as tools for securing food, protective devices against danger, lunar and solstice tracking mechanisms, structures aligned with celestial phenomena, and mathematical writings that reveal an advanced understanding of operations and geometry. Despite challenging periods in African American history such as enslavement, scientific racism, medical experimentation, Jim Crow laws, and the Freedom Movement, African Americans made significant contributions to STEM, achieving degrees, creating inventions—many of which were uncredited—and advancing the field. Today, however, African Americans are awarded the lowest number of STEM degrees and remain underrepresented in the STEM workforce (Bailey & Ojuok, 2024). This disparity reflects what Ladson-Billings (2006) terms the "education debt," which encompasses historical, economic, sociopolitical, and moral components of systemic inequities. Ladson-Billings explains that this debt represents an accumulation of disadvantages over time, rooted in unequal access to quality education, under-resourced schools, and discriminatory policies. Prime (2019) adds that teacher shortages in STEM fields, high teacher turnover and the predominance of White teachers in STEM education contributes to low African American participation in STEM. Bailey and Kornegay (2023) contend that conventional STEM curricula and teaching methods negatively affect African American engagement in these fields.

Efforts to increase African American participation in STEM by advancing racial equity in STEM education have gained momentum in recent years. Many initiatives now emphasize culturally responsive teaching, mentorship, and inclusive curriculum design. In this context, Dr. DeAnna Bailey introduced the African-Centered STEM Education (ACSE) Model, which integrates African[1] history, culture, and epistemologies—ways of thinking, learning, and knowing—into STEM instruction for African American

[1] The term “African” refers to people of African descent who trace their ancestral origins to the African continent..

learners, aiming to enhance both their engagement and academic success in STEM (Bailey & Bowens, 2024). The Uhuru Academy Conscious Ingenuity (UACI) STEM Camp represents the first comprehensive implementation of the ACSE model's components (Bailey & Ojuok, 2024; UACI, n.d.).

The UACI STEM Camp is a two-week, half-day virtual program that enables national participation from African American students across the United States. Its primary goals are to foster interest in STEM through culturally resonant instruction and to introduce students to foundational concepts in cybersecurity, artificial intelligence, machine learning, and coding. The camp serves students aged eight to seventeen, enrolled in grades three through twelve. Initially launched in the summer of 2022, the camp has since been held for three consecutive summers and once during the winter break of 2024. Morgan State University's Center for Cybersecurity Assurance and Policy (CAP, n.d.) and the Center for Equitable AI and Machine Learning Systems (CEAMLS, n.d.) jointly sponsored the camp in 2023. In 2024, the CAP Center served as the sole sponsor. In the summer of 2022, 13 students (8 girls and 5 boys) participated in the UACI STEM Camp. Participation increased to 22 students (13 girls and 9 boys) in 2023, and to 26 students in 2024 (13 boys, 12 girls, and 1 student who preferred not to disclose their gender). The 2024 cohort included 9 students who engaged through a partnership with the 22 Ways Leadership Academy, which hosted a hybrid version of the camp. Additionally, 7 students (6 boys and 1 girl) attended the winter 2024 session. Contact hours were consistent across all three summer iterations of the camp.. Total contact hours were consistent across all three summer iterations. The total contact hours for the winter iteration was half of the summer interactions. Bailey and Ojuok (2024) provides a complete description of the standard implementation of the UACI STEM Camp.

The African-Centered STEM Education (ACSE) model served as the foundation for the curriculum and teaching strategies employed by the UACI STEM Camp instructors to engage students. The curriculum focused on African STEM history and engineering. The African STEM history lessons were designed to enlighten students on the contributions to STEM made by people of African descent from ancient times to present-day. These historical explorations aimed to help students form personal connections to STEM, foster a positive STEM identity, and develop an understanding of how their

ancestors perceived, applied, and advanced scientific and technological knowledge. For example, students learn about the Lembombo and Ishango bones, the world's oldest mathematical instruments and African American STEM professionals such as Katherine Johnson who used advanced mathematics to calculate a safe trajectory for a NASA spacecraft. The engineering lessons were designed to expose students to foundational knowledge in cybersecurity, artificial intelligence, machine learning and coding. Topics include an introduction to Internet of Things (IoT) devices, cybersecurity concepts such as Confidentiality, an introduction to artificial intelligence and types of machine learning tools such as neural networks. All lessons included formative assessments to gauge the students' understanding of the content prior to, during and after exposure to the lesson. Each lesson began with a fun and interactive quiz such as Kahoot or a question prompt to assess students' familiarity with the topic, followed by a warm-up activity pertaining to the previous lesson to help students recall key topics and gauge how well they retained them. Knowledge checks were embedded throughout each lesson to determine if students grasped the information presented during instruction. These knowledge checks included the following:

- Thought and discussion prompts
- Call and Response
- Interactive videos with embedded questions
- Fun and interactive quizzes and polls
- Exit tickets to ensure key points

In addition to providing students with the opportunity to further their understanding of the lesson content, the knowledge checks were also a mechanism used to prepare the students for summative assessment.

Teaching strategies aligned with the ACSE model were employed by the UACI STEM Camp instructors to engage students. Strategies included the use of culturally relevant imagery and media, call and response, African griot teaching style, communal and cooperative learning. The UACI STEM Camp participants who engaged in the summer of 2023 and summer of 2024 completed pre- and post-program surveys to assess how the camp's strategies impacted the participants' familiarity of contributions to

STEM made by people of African descent, their interest, confidence and self-reported knowledge in STEM, particularly in cybersecurity, artificial intelligence and machine learning, and to evaluate student overall thoughts about and experiences in the program. Statistical analyses of the 2023 summer program surveys showed that the camp's strategies increased the participants' interest, confidence and self-reported knowledge in STEM (Bailey & Ojuok, 2024). To determine if the participants' self-reported increase in knowledge correlated with actual gains in African STEM historical, cybersecurity, artificial intelligence, and machine learning knowledge, the camp implementers gave the participants of the 2024 summer program a pre- and post-summative knowledge test on African STEM history and a pre- and post-summative knowledge test on cybersecurity, artificial intelligence and machine learning, in addition to the standard pre- and post-program surveys. The content of this paper includes an overview of the African-Centered STEM Education (ACSE) model, a description of Uhuru Academy Conscious Ingenuity (UACI) STEM Camp's strategies, a discussion of the impact of the camp's strategies on student interest, confidence and and learning determined by the pre- and post- program surveys, and an examination of the influence of the strategies on student learning, as evidenced by the scores on the pre- and post-UACI summative knowledge tests on African STEM history, cybersecurity, artificial intelligence and machine learning.

Overview of the African-Centered STEM Education Model

The African-Centered STEM Education (ACSE) model is a human-centered approach that integrates African cultural perspectives, values, and ways of knowing into STEM education to create inclusive, relevant, and empowering learning experiences for African students. This educational model originated from Dr. DeAnna Bailey, an engineering professor at Morgan State University, who desired to address the disinterest and disengagement of her African American[2] students. The objectives of the ACSE model are to:

- Create a meaningful connection between students and STEM
- Support the development of students' engineering identity formation

[2] The term "African American" refers to individuals of African descent whose ancestors were forcibly brought to the United States through the transatlantic slave trade and who have since developed a distinct cultural and historical identity within the American context

- Support student learning through teaching methods based on cognitive and epistemological frameworks of their culture
- Heal students from historical trauma and the effects of current system racism
- Affirm students' cultural identity
- Reconnect students to their cultural heritage and to others who share that heritage
- Provide an understanding of students' ancestors perceived and utilized STEM
- Encourage students to utilize STEM knowledge in ways that support and enhance the well-being of their families and communities

Achieving these objectives should foster greater interest and engagement in STEM among African American students, while also improving learning outcomes in educational environments predominantly composed of African American students.

Bailey and Bowens (2024) explains that ACSE model derived from African-Centered Education (ACE), which the authors define as "a restorative and preparatory educational process created to foster cultural and historical awareness and equip individuals with the critical consciousness, knowledge, skills, values, and morals needed to empower the African diaspora" (p.3). The ACSE model draws heavily from Akoto (1992)'s theoretical framework for ACE which is built on six key elements: cultural centering, identity restoration, a focus on nation building, holistic development, liberation and empowerment, and the perpetuation of African values. The ACSE model applies the elements above in the context of STEM education. The initial key ACSE model features, according toe Bailey and Bowens (2024) were:

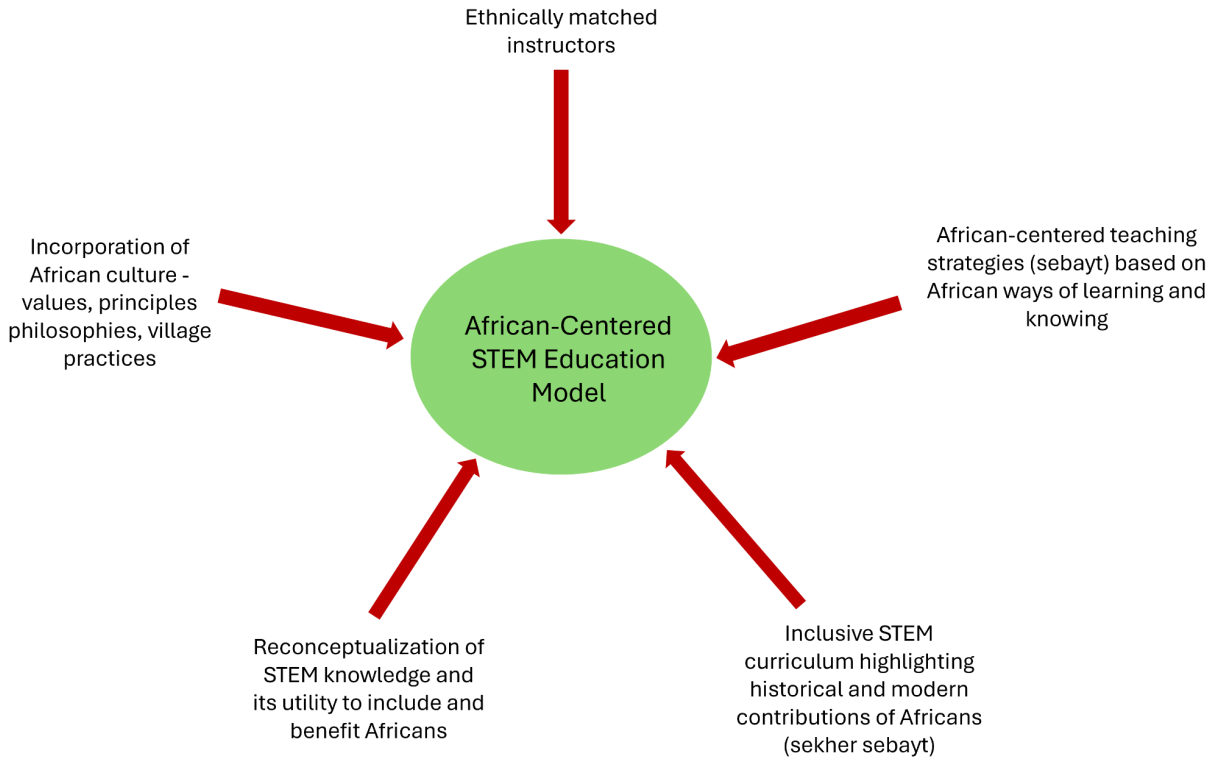
- Ethnically-matched instructors
- Interactive and collaborative learning
- STEM curriculum inclusive of contributions made by people of African descent
- African-centered teaching strategies - methods based on cognitive and epistemological frameworks of African American culture
- Incorporation of African values, principles and philosophies
- Integration of African ethnic and village practices

Recently, the model features were refined to more clearly articulate the foundational components of the African-Centered STEM Education (ACSE) model and to enhance its practical application in instructional settings. As part of these refinements, elements such as African values, principles, village practices, and

philosophies were consolidated under the broader category of African culture to provide a more cohesive cultural foundation. African-centered teaching strategies were updated to explicitly align with African ways of learning and knowing, which encompass epistemologies, cognitive frameworks, and culturally grounded instructional practices. This update was made to ensure conceptual clarity by accurately reflecting that epistemologies and cognitive frameworks are integral components of African ways of knowing, not separate from them. Additionally, interactive and collaborative learning was removed as a distinct feature, as it is more appropriately situated within instructional strategies, and a new emphasis was introduced on the reconceptualization of STEM knowledge and its utility, underscoring the importance of integrating African perspectives and students applying STEM to improve their families and communities. Figure 1 presents the updated model features, reflecting the conceptual adjustments made to strengthen the clarity, coherence, and instructional relevance of the African-Centered STEM Education (ACSE) model.

Figure 1

Refined Features of the African-Centered STEM Education (ACSE) Model.



The African-Centered STEM Education (ACSE) model features are intentionally designed to increase STEM engagement, and enhance learning outcomes for African American students, while affirming cultural identity and reinforcing a sense of communal responsibility. The ACSE model incorporates racial/ethnic matching between students and instructors, recognizing the role of shared identity in fostering culturally affirming learning environments and improving STEM outcomes for African American learners (Dee, 2004; Milner, 2006). These instructors are more likely to employ culturally responsive approaches and understand the lived experiences of African American learners, fostering a more affirming learning environment. African-centered teaching strategies such as call and response, communal learning, and the use of proverbs are rooted in African ways of learning and knowing. These strategies align with how many African American students naturally process and engage with information (Asante, 1991; Akoto, 1992; Shockley, 2011). The model also includes an inclusive STEM curriculum that highlights the historical and contemporary achievements of African people in STEM, which not only counters the erasure of African contributions but also helps students build a sense of pride, belonging, and possibility within STEM fields (Hilliard, 1995). Furthermore, exposure to the African people's achievements in STEM offers students critical insights into how their ancestors understood, applied, and innovated within these disciplines, affirming their cultural legacy and intellectual heritage. Another core feature is the reconceptualization of STEM knowledge and its utility. Currently, STEM knowledge is often presented through a Western lens that marginalizes or omits African perspectives. The ACSE model challenges this paradigm by affirming the intellectual contributions of African civilizations and integrating African ways of knowing into STEM instruction. Moreover, the utility of STEM knowledge is redefined to align with African-centered notions of functional education—education that serves the needs of the community and promotes self-determination (Nobles, 2006; Woodson, 2006). Finally, African culture serves as the philosophical and moral foundation of the model, encompassing African values, principles, and village practices that support cultural identity development, moral consciousness, and the creation of a communal, morally grounded learning environment (Akoto, 1992). Together, these features work in concert to create a culturally congruent STEM learning experience that inspires, empowers, and equips African American students for success in both education and life.

UACI STEM Camp Cultural Practices and Teaching Strategies

UACI STEM Camp instructors implemented cultural practices and teaching strategies rooted in the African-Centered STEM Education (ACSE) model to engage students (Bailey & Ojuok, 2024). The cultural practices included ancestor reverence, the use of familial and affirming African terms, and communal closing exercises. Ancestor reverence is a custom and tradition in African societies where ceremonies begin by honoring ancestors to connect the past and present (Matthews, 1998). Each session opened with instructors and students naming ancestors, responding with "Ase" (a Yoruba word meaning "so be it"), and pouring water into a plant. The purpose of engaging in this custom is for students to honor their heritage and strengthen their connection to the African diaspora. The word "Ase" was also used to affirm and praise students for correct answers to questions. Familial African terms were used, with instructors addressed as "Mama" or "Baba" and peers referred to as "brother" or "sister", reflecting the African cultural values of communal respect and familial bonds (Wilson et al., 1995). Swahili phrases like "Asante sana" (thank you) and "Karibu" (you're welcome) further immersed students in African language and culture. The day ended with a communal closing exercise called, "Community", a reflective practice rooted in African traditions of communal discussion, where all perspectives are valued for the collective's success (Etta et al., 2016). Students shared their thoughts on the day's activities, and instructors reinforced concepts while gathering feedback. These practices, as described by Bailey and Ojuok (2024), cultivated an engaging, culturally grounded and affirming environment for STEM learning.

UACI STEM Camp instructors utilized teaching strategies that aligned with the cognitive and epistemological frameworks of African culture to enhance student learning (Bailey & Ojuok, 2024). These strategies included incorporating culturally relevant media, call and response techniques, storytelling, and group activities involving problem-solving of culturally relevant scenarios. For example, instructors used vibrant lesson slides featuring African color themes and STEM pioneers, and played animated videos with African characters, music, and proverbs, all designed to connect students to their cultural roots, recognize STEM as an integral part of their cultural heritage and inspire them to see themselves as future STEM professionals. The instructors also utilized call and response, a cultural

practice, as a teaching strategy to reinforce key concepts and promote active participation (Akua, 2020). Call and response involves a back-and-forth exchange where a leader makes a statement or asks a question (the call), and the group responds in unison or with a predetermined reply (the response). This practice is commonly observed in African American religious institutions, musical concerts, and justice rallies, and aligns with African oral traditions. The instructor also used call and response during the reciting of a creed each day that was designed to encourage students to be the best version of themselves, represent their families well, foster a sense of belonging to a community and affirm their abilities. Storytelling, humor, and cultural analogies, reminiscent of the African oral tradition (Edosomwan & Peterson, 2016). were used to engage students while fostering connections between lesson content and their lived experiences. Hands-on group activities were integral, allowing students to collaborate and apply STEM concepts, an effective teaching strategy shown to support learning and engagement among African Americans (Coleman et al., 2023). These teaching methods reflected African cultural traditions and were designed to bolster confidence, engagement, and understanding among camp participants. Through this approach, the UACI STEM Camp provided a culturally affirming and educationally effective experience for African American learners.

Impact of the UACI STEM Camp Strategies

The participants of the summers of 2023 and 2024 UACI STEM Camp completed pre- and post-program surveys to measure the impact of camp's cultural practices and teaching strategies. The program surveys were adapted from the Student Attitudes Toward STEM (S-STEM) Survey (Friday Institute for Education Innovation, 2012), with additional questions about students' knowledge of STEM contributions made by people of African descent, their feelings about learning these contributions, their experiences in the program, and their reactions to being taught by ethnically matched instructors. The pre- and post-program surveys for 2023 and 2024 were similar; however, the 2024 surveys were refined to more efficiently capture the specific information desired by the implementers, and to collect more data specifically on the cultural practices implemented during the camp.

Impact of Cultural Practices

In the summer of 2024, 80% of respondents reported that participating in African cultural activities such as ancestor reverence at the beginning of camp and the communal exercise at the end of camp made them feel connected to their African roots. Eighty percent of the respondents also indicated that the use of the African cultural term “Ase” and the call and response Conscious Creed, both used to affirm and praise them, motivated them. Additionally, 70% reported that the use of the familial terms “Baba” and “Mama” made them feel a part of the UACI community. A strong majority of participants reported a deeper connection to their African heritage and a sense of belonging within the program community, underscoring the positive influence of these cultural and teaching approaches on their overall experience.

Impact of Teaching Strategies

Participants from both summers expressed a positive evaluation of the camp’s teaching strategies. Ninety five percent of the students in the summer of 2023 indicated they “liked how things were taught”, while 85% of the students in the summer of 2024 reported the same. As seen in Table 1, high percentages of students in both years expressed the strategies employed increased their interest, confidence and knowledge in STEM. Additionally, participants conveyed that these strategies motivated them, fostered a sense of belonging and excitement about learning more in these subject areas.

Table 1

Level of Agreement Post-Program Survey Results

	Summer 2023 UACI STEM camp	Summer 2024 UACI STEM camp
Post-program surveys questions	**% Agree or Strongly Agree**	
After this camp, I feel more confident that I can do well in science, technology, engineering, and math.	95%	75%
This camp made me excited to learn more about science, technology, engineering, and math.	95%	75%
This camp made me more aware of contributions made by people of African descent.	90%	90%
I learned a lot in this camp.	95%	85%
I liked how this camp taught things.	95%	85%
I felt like I belonged at this camp.	100%	70%
I had fun at this camp.	100%	75%
This camp made me feel inspired & motivated.	90%	70%

In the summer of 2023 UACI STEM camp surveys, student participants reported, from pre to post program survey results, an increase in their intentions to pursue advanced STEM courses, with notable growth in Artificial Intelligence (from 30% to 50%) and Machine Learning (from 10% to 30%). In the summer of 2024 UACI STEM camp surveys, student participants reported, from pre to post program survey results, an increase in their intentions to pursue advanced STEM courses, with notable growth in Cybersecurity (20% to 55%) and Artificial Intelligence (from 30% to 45%). In 2023 pre and post program survey results, student participants reported increases in their self-reported expectations to perform "Very well" in STEM classes: Science (from 55% to 84%), Math (from 30% to 50%), Computer Science (from 47% to 77%), and Engineering/Technology (from 38% to 88%). In 2024, UACI STEM camp participants reported increases, from pre to post program, in their self-reported expectation to

receive “Grade A” in STEM class including an increase from 30% to 45% in engineering/technology class and from 40% to 60% in math class.

The UACI STEM Camp stood out to 85% of participants in the summers of 2023 and 2024, who noted its distinct focus on African contributions to STEM as a key difference from other programs they had attended. Student responses across both years reflected overwhelmingly positive experiences, emphasizing the camp’s success in supporting STEM engagement and cultural awareness through the African-Centered STEM Education (ACSE) model.

Impact on Student Interest, Confidence and Knowledge in STEM

The pre- and post-program surveys conducted during the summers of 2023 and 2024 also assessed the impact of camp strategies on students' interest, confidence, and self-reported knowledge in STEM. In 2023, participants were asked to respond to statements measuring their level of agreement regarding confidence, interest, and self-reported knowledge in STEM subjects. Students reported increased gains in interest and confidence in STEM on 100% of the level of agreement statements in the survey. In 2024, the survey questions were revised, reflecting an improvement in data collection on participants' interest, confidence, and self-reported knowledge about the subjects of STEM by asking the same questions for each of the subjects for direct comparisons. Table 2 displays the percent increase of the average response rate of each survey question across the STEM subject areas from pre- to post-survey.

Table 2

2024 UACI STEM Camp Pre/Post percentage increase of average response rating

	Percent increase of the average response rating from pre to post			
Survey question	**Science**	**Engineering**	**Technology**	**Math**
Understanding/Knowledge	13.6%	17%	5%	5%
Likelihood as career	12.7%	13.2%	9.5%	1.7%
Success in subject area	2.9%	10%	7.5%	1.4%
Interest level	*-1.5%	8.3%	4%	*-6%

*decreased reported average response ratings from pre to post in interest level in Science and Math

Assessing Student Learning

In order to gain a more objective assessment of the self-reported knowledge gains, two summative knowledge tests were administered at the beginning (pre) and at the end (post) during the 2024 UACI STEM summer camp. One summative knowledge test focused on African STEM history and the other on Cybersecurity, Artificial intelligence (AI) and Machine learning (ML). The African STEM history test was created by an Uhuru Academy instructor, and the Cybersecurity and AI/M test was created by an electrical engineering professor For an initial content validation, both tests were reviewed by a K-12 curriculum expert. Administering the summative knowledge tests to the 2024 cohort allowed data collection for further validation, and data collected during future UACI STEM camp sessions will allow further refinement of the tests. The tests consisted of various content areas covered throughout daily lessons for the duration of the program. The African STEM history test covered topics such as geography and natural resources, African history, culture, science, inventions and innovations. The cybersecurity and AI/ML test covered a range of topics, including Integrity, Cyber Ethics, Cryptography, Online Safety, and Artificial Intelligence. These content areas were assessed through the use of multiple choice question prompts on both tests. Data were analyzed using SPSS to compute descriptive statistics such as percentages. To assess changes on the summative knowledge tests, paired (repeated-measures) t-tests were computed to see if there were statistically significant differences between average participant scores before (pre) and after (post) the UACI STEM camp program.

For the participants whose pre- and post-summative African STEM history knowledge tests could be matched (n=22), the average cumulative test scores (pre=49%; post=88%) were statistically significantly higher at the end of the 2024 UACI STEM camp: paired $t(21) = -11.91$, $p = 8.4e^{-11}$. Table 3 presents the percentage of correct answers from participants learning assessment scores for African contributions to STEM, with 100% of questions demonstrating an increase in correct answer rates.

Table 3

2024 UACI STEM Camp Percentage Correct Answers - African contributions in STEM Learning Assessment Questions

	Pre (n=22)	**Post (n=22)**
Which river was the main water source for the “Fertile Crescent” of East Afrika?	59%	95%
Which river was the main water source of the “Fertile Crescent” of West Afrika?	50%	95%
What is it called when a community doesn't have access to fresh food?	55%	100%
Mathematics is a scientific tool created by Afrikan people for the purpose of studying what?	23%	91%
How old is the Great Pyramid?	77%	100%
At Conscious Ingenuity, what does STEAAM stand for?	50%	82%
Name two Ancient West Afrikan cultures that are famous among scientists because of their astrological knowledge.	36%	73%
What is the name of the 2nd Black woman astronaut to go to space?	23%	59%
Name the Black inventor that invented the gas mask.	64%	95%
The CAP Center is located at which HBCU?	50%	91%
Mean Number Correct	**5.3**	**8.6**

For the participants whose pre- and post-summative Cybersecurity and AI/ML knowledge tests could be matched (n=16), the average cumulative test scores (pre=70%; post=84%) were statistically significantly higher at the end of the 2024 UACI summer camp: paired $t(15) = -3.78$, $p = .018$.

Table 4 presents the percentage of correct responses from participants' learning assessment in Cybersecurity and AI/ML, with ten out of eleven questions demonstrating an improvement in correct answer rates. The objective measure of both cybersecurity and AI knowledge and African contributions in STEM knowledge helps to support participants’ self-reported knowledge gains in the areas of STEM.

Table 4

2024 UACI STEM Camp Percentage Correct Answers - Cybersecurity/AI Learning Assessment Questions

	Pre (n=16)	**Post (n=16)**
What does IOT stand for?	44%	81%
Which of these can be part of the Internet of Things (IoT) that connects to the internet? (Examples of IOT devices)	94%	100%
What is cybersecurity?	94%	100%
Define Confidentiality	69%	75%
What is Cryptography?	75%	81%
What is artificial intelligence?	75%	100%
Which of the following is a common application of Machine Learning?	6%	31%
Imagine you have a program that learns to identify different types of flowers based on pictures. It uses a neural network to achieve this. How might the neural network learn to distinguish between a rose and a daisy?	63%	81%
Which of these devices uses Artificial Intelligence (AI) to function?	100%	100%
Imagine a robot is helping a doctor diagnose patients. Some people worry that AI might not always be fair in its decisions. Why might this be a concern?	81%	88%
Mean Number Correct	**7.01**	**8.37**

Conclusion

The African-Centered STEM Education (ACSE) model offers a transformative framework for integrating African achievements, culture, cognitive and epistemological frameworks into STEM education. By addressing systemic barriers and fostering cultural identity, empowerment, and academic excellence, the model creates an inclusive and affirming learning environment for African American STEM learners. Through its holistic and culturally grounded approach, the ACSE model equips students with the skills, confidence, and sense of purpose needed to excel in STEM fields and positively impact their communities. Data collected from the UACI STEM Camp, a practical implementation of the ACSE

model, demonstrates the model's effectiveness in increasing the interest, confidence and knowledge of African American STEM learners, while affirming their cultural identity and fostering cultural pride.

Future Work

Data analyzed from the 2023 and 2024 summer cohorts of the UACI STEM Camp demonstrate the effectiveness of the program's culturally grounded practices and instructional strategies, which were informed by the African-Centered STEM Education (ACSE) model. Based on these findings, we plan to research, implement, and evaluate additional practices and strategies. This will involve exploring more African cultural practices, as well as African cognitive and epistemological frameworks. Our goal is to scale the UACI STEM Camp, reaching more African American STEM learners and collecting data from larger sample sizes. This expansion will help strengthen our confidence in the conclusions regarding the UACI STEM Camp's cultural practices and teaching strategies, ultimately supporting the ACSE model. Scaling the UACI STEM Camp will require additional resources, including staffing, funding, and partnerships with organizations that share our mission. It will also involve refining our data collection processes to accommodate the larger scale while maintaining the quality and effectiveness of the program.

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