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Empirical Paper

Culturally Responsive Pedagogy in Cybersecurity Education: Evidence from African Secondary Schools

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Abstract

Purpose: This study examines the effectiveness of the Culturo-Techno-Contextual Approach (CTCA) in improving secondary school students' academic achievement in cybersecurity. The CTCA integrates culture, technology, and context to promote meaningful learning and is grounded in cognitive constructivist, meaningful learning, social constructivist, and eco-cultural theories.

Methods: A quasi-experimental pre-test–post-test control group design was employed with 106 secondary school ICT students in Africa. The experimental group (n = 54) was taught using the CTCA, while the control group (n = 52) received conventional lecture-based instruction. Achievement was measured using the Information Security Achievement Test (ISAT), which demonstrated satisfactory reliability (Cronbach's α = 0.82; test–retest reliability = 0.79). Analysis of covariance (ANCOVA) was conducted using pretest scores as covariates to control for baseline differences.

Results: Students taught using the CTCA achieved significantly higher post-test scores (M = 26.59, SD = 3.27) than those taught using the lecture method (M = 17.62, SD = 3.06). ANCOVA revealed a significant treatment effect, $F(1, 103) = 615.83$, $p < .05$, confirming the effectiveness of the CTCA in enhancing cybersecurity achievement.

Novelty and Contribution: This study extends the application of the CTCA to cybersecurity education, providing empirical evidence for a culturally responsive, technology-enhanced instructional approach that strengthens constructivist learning in African secondary schools.

Social and Practical Implications: The findings support the adoption of the CTCA by educators and policymakers to improve cybersecurity and ICT learning outcomes, strengthen digital competencies, and enhance students' preparedness for an increasingly digital society.

Keywords: Culturally Responsive Pedagogy, Cybersecurity Education, Culturo-Techno-Contextual Approach, Quasi-experimental design, ICT

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1 Introduction

The world has evolved to accommodate communication trends, data and information security, and numerous cutting-edge technologies. Over the past two decades, the ICT revolution has gained momentum and spread rapidly across nations, industries, and organisations, resulting in significant changes worldwide (Vu et al., 2020). The ICT revolution has impacted work, organisations, people, and economies. The ICT revolution has led to rapid economic growth, quicker and easier working methods, and increased labour productivity (Adeleye & Eboagu, 2019; Nguyen et al., 2022).

According to Das (2019), ICT is a broad category of technological resources and instruments used to share, create, disseminate, store, and manage information. Information and communication technologies (ICTs) are described as "information-handling tools" by the United Nations Development Programme (UNDP) as "a varied range of items, applications, and services that are used to produce, store, process, distribute, and exchange information." ICT refers to all forms of technology-enhanced communication that are used to speed up the transmission of information from one party to another. In this context, it refers to technology-supported communication channels. ICTs have reportedly changed several facets of our existence (Das, 2019). ICT has significantly impacted various industries in the past two or three decades, including engineering, architecture, law, banking, tourism, commerce, and medicine. These fields now function very differently from how they did in the past. This has had an impact on education and altered the global educational system (Adeoye et al., 2013).

On this basis, information security has become an integral part of our everyday lives, and organisations recognise the influence which it has on the behaviour of employees (Futcher et al., 2010). The challenge now falls on educational institutions to equip their students with the requisite knowledge, skills and attitudes necessary to ensure that they can participate responsibly within their communities and contribute towards the economic development of their societies. This lasting challenge can be curtailed and seen as accomplished when students can display an increased level of comprehension and understanding of the concepts taught in information security.

Information security as a concept in ICT education must be captured so that students will not be driven into giving out vital information they deem essential to unauthorised entities, which might be used against them now or in the future. This interest of students can be only achievable when students have prior knowledge about the concept and create an avenue for information security awareness. It is therefore to this effect that this study endeavours to explore the potency of the CTCA in the study of information security in an effort to improve students' interest and essentially facilitate their engagement in their daily lives.

Purpose of the Study

Reports highlighting poor student performance in computer studies and ICT across various countries have been prevalent in literature from the second decade of the twenty-first century. This persistent underachievement raises crucial questions about what underlying issues need to be addressed, what changes are necessary, and what innovative teaching strategies could boost students' performance in information security (cybersecurity). This study aims to evaluate the applicability and effectiveness of the CTCA) in teaching and learning ICT, with a specific focus on information security. Additionally, the study seeks to determine how this approach impacts student engagement and their interest in the subject, as well as their understanding of key concepts.

Teaching methods in Africa have largely borrowed from the West over the past few decades to give pupils the knowledge and skills required in many sections of the African economy. In particular, during the COVID-19 pandemic, according to Awaah (2020), a new Afrocentric teaching model that emphasises the use of digital technology in its methodology and delivery, as well as the significance of partnerships in meeting the needs of higher education on the continent, offers a comprehensive teaching and learning model. He asserts that strict educational policies in the past must have resulted from colonial rule in Africa. Creating a teaching strategy that considers African ideas, lifestyle, environment, and upbringing may be the long-awaited solution to this problem and teaching technique threat. In view of this, the purpose of this study is to explore the potency of the culturo-techno-contextual approach on students' performance in information security (cybersecurity).

Research Questions

To achieve the main objectives of this study, the following questions were raised to guide the study:

i. Will there be any statistically significant difference in the academic achievement of students taught Information Security using the CTCA and the lecture method?

ii. What are the perceptions of students on the impact of CTCA on information security?

2 Literature Review

Cybersecurity (Information Security)

An appropriate definition is necessary because information security is such a large topic. Information systems security and "computer security" are frequently used interchangeably in the literature. Domains, functions, and concepts can be used to define computer security, according to Ross (1999). Physical, operational, personnel, systems, and network security are the different domains of computer security. Computer security can be divided into risk avoidance, deterrent, prevention, detection, and functional recovery domains. Confidentiality, integrity, authentication, access control, non-repudiation, availability, and privacy comprise computer security.

According to McDaniel (1994), information security refers to the ideas, methods, technical, and administrative safeguards used to guard against either intentional or unintentional unlawful acquisition, destruction, disclosure, manipulation, alteration, loss, or use of information assets. Maintaining confidentiality, safeguarding data from unwanted access, ensuring data integrity and correctness, and promptly making data available to authorised users are other examples of information security (Stallings, 2008).

An aspect of an information security program that is sometimes disregarded is security awareness. While businesses improve their usage of cutting-edge security technology and continually train their security personnel, more must be done to raise security awareness among everyday users, who remain any organisation's weakest link (Aloul, 2012). According to the author, the rise of electronic data, mobile devices, organised cybercrime groups, and intelligent outsiders is primarily to blame for the global surge in information technology (IT) security issues, internal challenges to IT security, difficulty identifying attackers, a lack of effective cybercrime regulations, and low IT security awareness among internet users.

Students (ages 18 to 24) are prime targets for security threats since they pose a high risk. This can be explained by the fact that students frequently move around and have less established adult credit histories (Marks, 2007). A student might unknowingly download a Trojan horse onto his computer and fall prey to a cunning social engineering attempt if they get a web postcard in an email (Marks, 2007). In this environment, information technology professionals in industrialised nations, particularly the United States, are urging schools and their leaders to safeguard their campus computer networks by capitalising on increased public safety awareness.

Using ICT in the classroom can enhance students' understanding and interpretation of the learning process and future professional endeavours (Tikhonova & Tereshkova, 2014). The next innovation will restructure the ICT course material to give students a practical, hands-on understanding of the subject. Today's students have experience and employment options in computer programming, graphic and web design, data analytics, tech support, security analysis, and network analysis.

Students' Academic Achievements

A significant topic of education research is academic performance. It deals with how well students can meet their academic objectives and goals, as shown by their grades, test results, and other learning indicators. Understanding the variables impacting academic success and how teachers might assist students in realising their full potential has received much scholarly attention (Ivwighreghweta & Igere, 2014; Adu and Olatundun, 2007; Akiri, 2013).

The degree to which pupils can study, take exams, and pass them successfully is measured by their academic achievements. According to Steinmayr, Meier, Weideinger, and Wirthwein (2014), academic achievement is a performance outcome that measures how well a person has achieved particular objectives that were the focus of activities in instructional environments, specifically in school, college, and university. Academic success should be

viewed as a complex construct that includes various learning areas, including critical thinking, numeracy, problem-solving, etc. Because academic accomplishment has been the primary determinant of a student's success in school, intellectual achievement has become the main emphasis of education.

One of the most studied aspects of academic performance is the factors that influence it. Academic performance factors can be divided into two broad categories: student-related and environmental factors. Student-related factors include intelligence, motivation, self-efficacy, and other individual characteristics. Ecological factors include family background, socioeconomic status, and the quality of the educational environment. Numerous studies have found that intelligence strongly predicts academic performance, with higher intelligence associated with higher grades and test scores. Motivation and self-efficacy are also important, as students who believe they can achieve academic success are likelier to do so (Tella et al., 2011; Salami & Ogundokun, 2009; Ugwuanyi & Okeke, 2020; Akomolafe et al., 2013).

Some individual and environmental predictors account for a student's academic prowess in school. Many studies (Nasrullah & Khan, 2015; Fan, 2012; Shute et al., 2011) have studied some of these predictors.

According to Nasrullah and Khan (2015), a student's academic achievement depends heavily on their ability to manage their time well. According to the authors, one of the factors that can influence a student to be a good student is time management. For pupils to excel, effective time management is essential. Fan (2012) also noted that strong relationships between students and professors allow for one-on-one academic interactions that can assist students in developing their comprehension, which is necessary for academic success. According to Shute et al. (2011), parental involvement in their children's schooling has a favourable impact on their academic success.

Academic achievement has also been found to be significantly influenced by environmental factors. For instance, students from higher socioeconomic backgrounds typically outperform students from lower socioeconomic backgrounds in academic performance. Academic success is also substantially impacted by the educational environment's quality, including the calibre of instruction, school supplies, and curriculum (Adeyemi & Adeyemi, 2014; Bakare, 2015; Adeyemo, 2005; Saanu, 2015).

Other research has looked into how teaching strategies affect students' academic achievement. According to Chen and Yan (2019) and Gull and Shehzad (2015), project-based learning and cooperative learning are two teaching strategies that help students perform better. Students can learn more effectively and perform better in class when their teachers use teaching strategies to encourage class participation through practical application and interaction with other students. The authors recognised cooperative and project-based learning as successful teaching strategies.

Because academic achievement is so important, educators and researchers have focused a lot of attention on creating treatments that can assist students in enhancing their learning outcomes. After-school activities, mentoring, and tutoring are a few common solutions. Using technology to improve learning is one strategy that has gained favour recently. As an illustration, educational software and online learning platforms can offer students tailored learning opportunities while enabling teachers to monitor student progress and give pertinent comments (Olufemioladebinu et al., 2018; Ukwetang et al., 2021; Osokoya, 2010).

In conclusion, research on academic performance has revealed a range of factors that influence student learning outcomes, as well as numerous interventions that can help to improve academic performance. While there are significant challenges to achieving academic success, researchers and educators continue to work towards developing effective strategies to support students in their learning journeys.

Theoretical and Philosophical Underpinnings of the Study

The study of the CTCA has spanned over forty years of research by Professor Peter Akinsola Okebukola of the Lagos State University and was unveiled in 2015 as an additional method to the existing toolkits for the teaching and learning of science (Okebukola, 2020). The CTCA is a teaching strategy focused on culture, technology, and the context and social milieu in which learning and teaching occur (Okebukola, 2020). The method combines the strengths of three frameworks: (a) the cultural context in which all students are immersed; (b) the technological medium on which teachers and students are increasingly reliant; and (c) the geographic context, which is a distinctive feature of every school and which is heavily weighted in the examples and local case studies for science lessons (Okebukola, 2020).

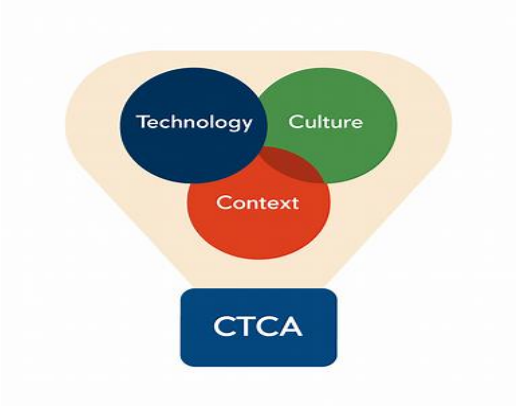

Figure 1 The CTCA diagram sourced from Gbeleyi (2025)

The CTCA was created with three key theories as well as three key philosophies. These theories and philosophies underpin the invention of the CTCA. The CTCA is based on the learning theories of Jean Piaget, Lev Vygotsky's social constructivism theory, and David Ausubel's idea of advanced organisers. Kwame Nkrumah's ethnophilosophy, Martin Heidegger's technophilosophy, and Michael Williams ' contextualism philosophy underscore the CTCA's invention. All of which contributed to the advancement of this study. The foundation of Vygotsky's social constructivism, also known as sociocultural theory, is the idea that the growth of higher psychological functions is a social process in which peers, parents, other caregivers, and the greater society and culture all play important roles. Children might actively generate their knowledge, in his opinion. Vygotsky (1962) claimed that cognitive development results from a dialectical process in which a child learns by working with peers, teachers, parents, and other family members to solve problems.

Students' information security (cybersecurity)

Student information security (cybersecurity) involves protecting student data and devices from threats like phishing, malware, and weak passwords, requiring both individual awareness (strong passwords, 2FA, careful clicking) and institutional support (training, secure systems) to build safe digital habits, especially as learning increasingly moves online. Key areas focus on password management, email safety, recognising suspicious links, using multi-factor authentication, and understanding digital citizenship to secure personal information and institutional data (Al Zaidy, 2025).

Farooq et al. (2015) conducted a study to investigate information security awareness (ISA) among university students and examine the impact of various individual factors on ISA. The researchers employed a descriptive survey method and administered a questionnaire consisting of 30 items to collect data from 614 respondents at their university. They analysed the relationships between individual factors and perceived ISA levels using Pearson's correlation coefficient. In contrast, factors such as age, nationality, discipline and level of education have statistically insignificant correlations with attained ISA level. Furthermore, gender and training correlate statistically significantly with the perceived ISA and the dimensions of ISA, that is, knowledge and behaviour. Age and experience significantly correlate with perceived ISA, whereas living area correlates with knowledge only. The findings from the study gave a deeper insight into ISA among university students.

The study collected data from a substantial number of participants (614), enhancing the reliability and generalisability of the findings. The researchers also designed a comprehensive questionnaire comprising 30 items, allowing for a comprehensive assessment of various aspects related to ISA. Although the study examined several individual factors, it did not consider other potentially relevant factors that could impact ISA, such as socioeconomic background or personal attitudes toward information security.

3 Methodology

Research Design

This study employed a mixed-method research design, specifically using an explanatory sequential design. This approach involves gathering both quantitative and qualitative data to better clarify and understand the study's objectives. On the other hand, qualitative research allows for a more targeted exploration, encourages discussion, and yields in-depth insights into a phenomenon (Ikeda, 2009). Leveraging the advantages of both types of research, this study utilised a mixed-method research design. Yin (2018) observed that combining quantitative and qualitative approaches enables researchers to address more complex questions.

Variables of the Study

The variables of the study are:

- Independent variable: Teaching methods (CTCA and lecture method)
- Dependent variable: Achievement test

Population of the Study

The population comprises students from co-educational schools with an age range of 11-20 years. There was a total of 4,584,381 students attending basic schools in Ghana in the year 2024. The sample size was between 50 and 60 students, as that's the standard class size. The sample will be of mixed-ability, mixed gender groups. The rationale for using JHS 3 students for this study is that information security is an integral lesson in the JHS curriculum, and as such, they would not have been taught the topic of interest in this study — Information Security. Different schools were chosen for each group to prevent any interaction between the classes that could influence the study's results. The study employed a multi-stage sampling technique, incorporating two sampling methods: purposive and random sampling. Purposive sampling, a non-probability technique, selects the sample based on the researchers' intent for the study (Campbell et al., 2020). Therefore, purposive sampling was utilised to select schools for the study.

Instrumentation

Three instruments were used for the data collection, which include: the Information Security Achievement Test (ISAT), the CTCA Observation Scale (CTCA-OS). ISCPIQ was used to collect qualitative responses.

Development of the Instrument

Information Security Achievement Test (ISAT)

The Information Security Achievement Test (ISAT) was subjected to rigorous validation and reliability checks to ensure its effectiveness as a measurement tool. Content validity was established by deriving items from past examination questions in information security and having them reviewed by subject matter experts, including the project supervisor, to confirm adequate coverage of the subject matter. Construct validity was ensured by aligning the test items with core concepts such as confidentiality, integrity, availability, and risk management, thereby reflecting the theoretical foundations of information security. Pilot testing was conducted with a small group of students to assess clarity, difficulty, and item discrimination, and the feedback obtained guided necessary revisions to improve the instrument. Reliability was measured using Cronbach's Alpha, which yielded a coefficient of 0.82, indicating strong internal consistency, while test–retest reliability produced a coefficient of 0.79, demonstrating stability of scores over time.

1. Another name for the information security triad is:

a. The FBI triad c. The ISS triad

b. The CIA triad d. The IST triad

2. Which one represents the property of keeping an organisation's information accurate, without error, and without unauthorised modification?

a. Availability b. Confidentiality c. Integrity d. Accountability

3. Why are these 4 elements (confidentiality, integrity, authenticity & availability) considered fundamental?
   a. They help understand hacking better
   b. They are key elements to a security breach
   c. They help understand security and its components better
   d. They help to understand cybercrime better

Procedure for Data Collection

This study utilised a mixed-method approach, collecting both quantitative and qualitative data. Quantitative data were first gathered from experimental and control groups, followed by qualitative data from five students in the experimental group. After securing necessary permissions, a pre-test on Information Security was administered to both groups in a calm setting. The tests were completed within an hour, and the results were scored accordingly.

Treatment Procedure of the CTCA in the Experimental Group

The implementation of CTCA in the experimental group followed the five steps in implementing CTCA in the classroom (Okebukola, 2020). Implementing CTCA involves featuring the culture, technology and context frameworks in the delivery of every lesson. It follows a 5-step process.

These steps are:

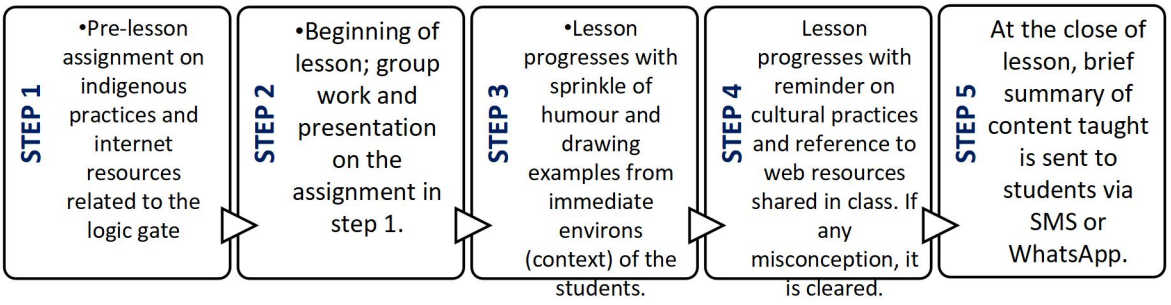

Figure 2 Implementation of the CTCA

Procedure for Data Analysis

This study used a mixed-method approach, collecting both quantitative and qualitative data. Quantitative data were gathered first from experimental and control groups, followed by qualitative data from five students in the experimental group. The process began with obtaining clearance and permissions. A pre-test on Information Security was administered to both groups, ensuring a calm environment. Students had one hour to complete the test, which was then scored. After the pre-test, the treatment phase began. The experimental and control groups received information security lessons over two weeks, each session lasting 80 minutes. The experimental group experienced the novel CTCA teaching strategy, while the control group received traditional lectures.

The first research question sought to identify whether the CTCA would significantly impact students' achievement in information security. A null hypothesis was developed that there would be no statistically significant difference between students taught using the lecture method and those taught using the CTCA in their achievement in information security. The Analysis of Covariance (ANCOVA) test was used to compare the means of students' achievement post-test scores whilst controlling for their achievement pre-test scores to determine whether there was a statistical difference.

The ANCOVA test has various assumptions that need to be tested to ensure that the results are valid and trustworthy. These assumptions include normality, which was tested using the Kolmogorov-Smirnov and Shapiro-Wilk tests, and homogeneity of variance, which was tested using Levene's test. The data analysis process followed the following steps: Student scores from the Information Security Achievement Test (ISAT) were carefully marked, and the scores from both the pre-test and post-test were recorded. These scores were then analysed using IBM-SPSS version 26 to calculate the mean scores.

4 Results

Participant Demographics

The demographic details of the participants are comprehensively outlined in Table 1. The study included 54 final students, accounting for 50.95% of the total, while 52 students made up 49.05%. Among the participants, females comprised a larger portion at 60.38%, with males at 39.62%. The majority of participants were aged 10-15, representing 50.94%, while those aged 15-20 constituted 49.05%. Additionally, a significant number of participants had parents with an education, totalling 101 individuals or 95.2%.

Table 1 Participant Demographics

VARIABLE		**N**	**%**
School	'1' JHS	54	50.94
	'2' JHS	52	49.05
Gender	Male	42	39.62
	Female	64	60.38
Age	10-15 years	54	50.95
	15-20 years	52	49.05
Parents' Educational Level	Educated	101	95.28
	Not educated	5	4.72

Fieldwork (2025).

Table 2 Pre-Test and Post-Test Achievement Mean Scores for Experimental and Control Groups

	GROUPS	**Mean**	**N**	**Std. Deviation**
Achievement Pre-test	Experimental	11.83	54	3.27
	Control	12.27	52	3.61
Achievement Post-test	Experimental	26.59	54	3.27
	Control	17.62	52	3.06

Source: Author's Computation (2025).

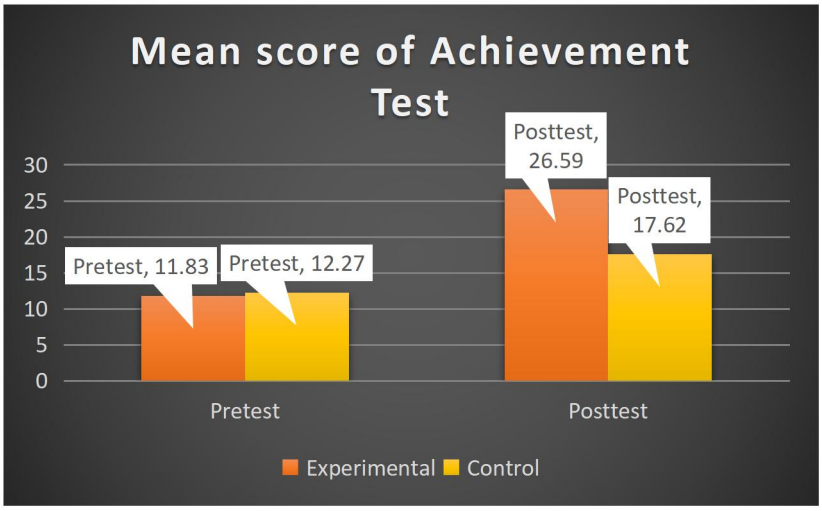

Figure 2 Mean score Graph of the Achievement Test of the Experimental and Control Group

The results in Table 2 and Figure 2 show that the experimental and control groups had comparable levels of achievement before the intervention. The experimental group obtained a pre-test mean score of 11.83 (SD = 3.27, *N* = 54), while the control group recorded a slightly higher mean score of 12.27 (SD = 3.61, *N* = 52). The small difference of 0.44 points between the two groups suggests that they were relatively similar in their academic achievement at the beginning of the study, indicating a fair basis for comparing the effects of the instructional intervention.

Following the intervention, the experimental group achieved a substantially higher post-test mean score of 26.59 (SD = 3.27), compared to 17.62 (SD = 3.06) for the control group. This represents an improvement of 14.76 points for the experimental group, whereas the control group improved by 5.35 points. The considerably greater gain in the experimental group suggests that the intervention was more effective in enhancing students' achievement than the conventional approach used with the control group. The relatively similar standard deviations across both groups also indicate that students' scores were consistently distributed around their respective means.

Following the tests of assumptions, the ANCOVA was used to test the hypotheses developed (Table 3). The ANCOVA analysis reveals a statistically significant difference in the achievement of students taught using the CTCA compared to those taught using the lecture method in information security [F (1, 103) = 615.83; p=000]. Following this result, the null hypothesis H01 was rejected.

The partial eta squared value for the treatment groups' effect, while considering the impact of pre-treatment scores as a covariate, was determined to be 0.86. This indicates that about 86% of the variation in the scores after treatment may be ascribed to the combination of the treatment groups and the scores before treatment. In practical terms, this shows a large effect size, meaning that the CTCA has a significant impact on the student's achievement.

Table 3 Analysis Of Covariance (ANCOVA) On Achievement Post-Test Scores of Experimental and Control Groups with Pre-Test Scores as Covariate.

Dependent Variable: Achievement						
Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	2796.86a	2	1398.43	377.69	.00	.88
Intercept	1386.17	1	1386.18	374.38	.00	.78
Achievement Pre-test	661.98	1	661.98	178.79	.00	.63
GROUPS	2280.1	1	2280.15	615.83	.00	.86
Error	381.36	103	3.703			
Total	55366.00	106				
Corrected Total	3178.23	105				
a. R Squared = .880 (Adjusted R Squared = .878)						

Source: Author's Computation (2025)

Perspectives of Students on the CTCA as a Teaching Method

The study also sought to collect students' views and perceptions on the use of the CTCA as an instructional method. The responses saw respondents highly advocating for the adoption of the CTCA as a teaching method, as it helped them understand the topic of information security.

As reported by the interviewed respondents on the difficulties faced in learning ICT topics before the intervention of the CTCA, the students generally reported negative experiences. For instance,

Afriyie (pseudonym), Female, 16 years: *The notes are too long and not straight to the point. I always get bored reading more because of that. Also, the teachers couldn't use our surroundings or things around us to help explain things better.*

Sly (pseudonym), Male, 17 years: *Before CTCA methods were used, ICT topics used to be very hard to understand because they came with long, complicated notes that made students feel bored and lazy to complete.*

Based on the feedback obtained from respondents, the lecture method utilised by the teacher was perceived as complex and challenging to comprehend. The explanations provided were often abstract, accompanied by excessively lengthy notes, making the learning process difficult. These findings align with the research conducted by Okebukola et al. (2021), Akintoye et al. 2023; Onowugbeda et al. (2022b), all of which identified a statistically significant difference between the CTCA approach and the traditional lecture method. This difference was attributed to the persistent challenge of conveying intricate concepts in the teaching and learning process. The consensus among these studies underscores the importance of exploring alternative teaching methodologies, such as CTCA, to overcome barriers and enhance the effectiveness of the learning experience.

The perspectives of students on the Culturo-Techno-Contextual Approach (CTCA) reveal strong support for its adoption as a teaching method, as they consistently reported that it made ICT topics easier to understand compared to traditional lecture methods. Respondents described their prior experiences with ICT lessons as negative, citing excessively long notes, abstract explanations, and a lack of contextual examples, which often led to boredom and disengagement. With the introduction of CTCA, however, students emphasised that lessons became clearer, more relatable, and engaging, as the method drew on cultural and environmental contexts to simplify complex concepts. These findings are corroborated by empirical studies such as Okebukola et al. (2021), Akintoye et al. (2023), and Onowugbeda et al. (2022b), which demonstrated statistically significant differences in learning outcomes between CTCA and lecture-based instruction, attributing CTCA's effectiveness to its ability to contextualise abstract ideas and reduce cognitive load. Similarly, Abdulhadi et al. (2024) and Awaah et al. (2023) found that CTCA enhanced comprehension and retention in ICT and science subjects, while Ekwam et al. (2022) reported its success in teaching programming by making abstract concepts more accessible. Taken together, both student perceptions and empirical evidence underscore CTCA's potential as a transformative instructional method that addresses persistent challenges in ICT education and fosters deeper learning.

The views of respondents were again solicited on their respective perceptions of the CTCA in learning ICT, and they gave their views. They revealed the following:

Sandra (pseudonym), Female, 15 years: *The CTCA method used by the teacher is good because instead of long notes, they send us shorter versions. This helps us understand the topics better.*

Nana Kwame (pseudonym), Male, 15 years: *The CTCA method has helped me in my studies because I don't have to spend a lot of time reading my notes. The topics are already explained in a way that I can easily understand.*

According to feedback from interviewed students, the preference for the CTCA method was attributed to the use of concise and summarised notes, focusing on key aspects of the topic. This approach resonated with the students, as it eliminated the need for extensive reading and allowed them to concentrate on crucial concepts. The students reported an increased interest in ICT classes, attributing this positive shift to the avoidance of cramming short notes, which had been a consequence of the traditional lecture method. This finding aligns with the idea that learning should be meaningful rather than based on rote memorisation, as advocated by Okebukola (2020), highlighting the advantages of the CTCA method in promoting a deeper understanding of the subject matter.

The students interviewed also revealed the aspects of the CTCA they enjoyed. The responses of the students revealed the following:

Abena (pseudonym), Female, 16 years: *I liked the example with our school environment, especially the example with the school's gate and the security man as a means of protecting the contents and people in the school from unauthorised people.*

Sly (pseudonym), Male, 17 years: *I liked the assignment that involved indigenous knowledge. Using cultural and indigenous knowledge helped us connect ICT topics to things we see every day, making it easier for me to understand the topic.*

Nana Kwame (pseudonym), Male, 15 years: *I liked watching YouTube videos on the topic. My dad watched it with me and explained some parts to me.*

Feedback from interviewed students highlights that the CTCA method, which integrates cultural and indigenous knowledge, made lessons simpler and more accessible compared to the lecture method. Students found this approach eliminated the need for lengthy notes, increased their interest in ICT classes, and improved academic performance by adapting topics to their understanding. The CTCA method's effectiveness lies in its combination of cultural context, technology, and the school's location. This approach helps students relate difficult concepts to their indigenous knowledge, enhancing meaningful learning and academic achievement. These findings align with previous research showing the CTCA method's positive impact on student performance.

Traditional & Cultural Methods related to information security (cybersecurity)

i. Oral Tradition: Storytelling, proverbs, songs, and folklore were the primary means of passing knowledge across generations. Elders and griots (custodians of oral history) played a central role.

ii. Symbols & Artefacts: Information was encoded in carvings, masks, textiles, and symbolic art, often used in rituals or community events.

iii. Community Gatherings: Town meetings, festivals, and ceremonies served as platforms for collective memory and information sharing.

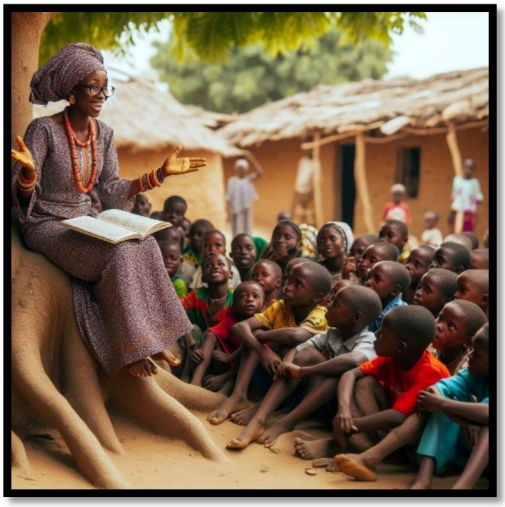

Figure 3 The Art of African Storytelling – Preserving Culture through Oral Traditions

5 Discussion, Implications, and Conclusion of CTCA Study

Study Limitations

This study, while offering valuable insights into students' perceptions of the Culturo-Techno-Contextual Approach (CTCA), has several limitations. The sample size was relatively small and restricted to JHS 3 students in selected Ghanaian schools, which may limit the generalisability of findings to other educational levels or regions. The reliance on self-reported perceptions introduces potential bias, as students may have provided socially desirable responses. Additionally, the study focused primarily on short-term outcomes, leaving questions about long-term retention and transferability of knowledge unanswered.

Suggestions for Future Research

Future research should consider larger and more diverse samples across different regions and educational levels to strengthen external validity. Longitudinal studies would be particularly useful to assess the durability of CTCA's impact on learning outcomes. Mixed-method approaches that combine quantitative achievement tests with qualitative interviews could provide a more holistic understanding of CTCA's influence on both cognitive and affective domains. Comparative studies across subject areas beyond ICT would also help establish the broader applicability of CTCA.

Implications for Theory Development

The findings contribute to constructivist learning theory by reinforcing the importance of contextualisation and cultural relevance in knowledge acquisition. CTCA demonstrates how integrating students' lived experiences and technological tools into instruction can reduce cognitive load and enhance comprehension, thereby extending existing theories of meaningful learning. This supports the development of pedagogical models that emphasise the interplay between culture, technology, and context in shaping effective teaching strategies.

Social and Practical Implications

Socially and practically, the implications are significant. Adopting CTCA can help bridge gaps in ICT education in developing contexts, making abstract concepts more accessible to students of mixed abilities. It promotes inclusivity by leveraging cultural and environmental contexts familiar to learners, thereby increasing engagement and reducing dropout rates. For policymakers and educators, the study underscores the need to move beyond traditional lecture methods and embrace innovative pedagogies that align with students' realities, ultimately contributing to improved ICT literacy and preparedness for the digital age.

Conclusion

This study examined the effectiveness of the Culturo-Techno-Contextual Approach (CTCA) in teaching information security to Junior High School students in Ghana. Findings revealed that students perceived CTCA as a more engaging and comprehensible instructional method compared to traditional lecture-based approaches, which they often described as abstract, monotonous, and difficult to follow. The ISAT instrument provided evidence of improved achievement, while qualitative feedback highlighted CTCA's ability to contextualise ICT concepts within students' cultural and environmental realities.

Although the study was limited by its relatively small sample size, reliance on self-reported perceptions, and short-term focus, the results contribute meaningfully to the growing body of literature on innovative pedagogies in ICT education. CTCA's emphasis on contextualisation and cultural relevance aligns with constructivist learning theory and demonstrates its potential to reduce cognitive load, foster inclusivity, and enhance meaningful learning.

In practical terms, the adoption of CTCA can help bridge gaps in ICT education in developing contexts, making abstract concepts more accessible to diverse learners. For policymakers, educators, and curriculum developers, the findings underscore the need to move beyond traditional lecture methods and embrace pedagogical innovations that resonate with students' lived experiences. Ultimately, CTCA offers a promising pathway toward improving ICT literacy, preparing students for the demands of the digital age, and contributing to broader educational reforms in Ghana and beyond.

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Conflict of Interest

The authors declare no competing interests.

Declaration of Use of Generative AI

Generative AI tools were used only as editorial support for paraphrasing, grammar checking, and formatting. All research ideas, analyses, interpretations, and conclusions were conceived, verified, and approved by the authors, who accept full responsibility for the content of this manuscript.

References

Adeleye, N., & Eboagu, C. (2019). Economic growth and ICT development in Africa. *Telecommunications Policy, 43*(5), 1–12. https://doi.org/10.1016/j.telpol.2018.12.004

Adeoye, B. F., Oluwole, A. F., & Blessing, O. (2013). ICT and educational development in Nigeria: Prospects and challenges. *International Journal of Education and Development using ICT, 9*(2), 112–123.

Adeyemi, A. M., & Adeyemi, S. B. (2014). Institutional factors as predictors of students' academic achievement in Colleges of Education in South Western Nigeria. *International Journal of Educational Administration and Policy Studies, 6*(8), 141–153. https://doi.org/10.5897/IJEAPS2014.0340

Adeyemo, D. A. (2005). Parental involvement, interest in schooling and school environment as predictors of academic self-efficacy among fresh secondary school students in Oyo State, Nigeria. *Electronic Journal of Research in Educational Psychology, 3*(1), 163–180.

Akiri, A. A. (2013). Teachers' effectiveness and students' academic performance in public secondary schools in Delta State, Nigeria. *Journal of Educational and Social Research, 3*(3), 105–111. https://doi.org/10.5901/jesr.2013.v4n3p105

Aloul, F. A. (2012). The need for effective information security awareness. *Journal of Advances in Information Technology, 3*(3), 176–183. https://doi.org/10.4304/jait.3.3.176-183

Campbell, D. T., Stanley, J. C., & Gage, N. L. (2020). *Experimental and quasi-experimental designs for research*. Houghton Mifflin.

Chen, C. H., & Yang, Y. C. (2019). Revisiting the effects of project-based learning on students' academic achievement: A meta-analysis investigating moderators. *Educational Research Review, 26*, 71–81. https://doi.org/10.1016/j.edurev.2018.11.001

Das, K. (2019). The role and impact of ICT in improving the quality of education: An overview. *International Journal of Innovative Studies in Sociology and Humanities, 4*(6), 97–103. https://doi.org/10.2139/ssrn.3523437

Fan, W. (2012). Parental involvement and students' academic achievement: A meta-analysis. *Educational Psychology Review, 24*(1), 1–26. https://doi.org/10.1007/s10648-011-9182-x

Farooq, A., Isoaho, J., Virtanen, S., & Isoaho, J. (2015). Information security awareness in educational institutions: An analysis of students' individual factors. In *2015 IEEE Trustcom/BigDataSE/ISPA* (Vol. 1, pp. 352–359). IEEE. https://doi.org/10.1109/Trustcom.2015.357

Gull, F., & Shehzad, S. (2015). Effects of cooperative learning on students' academic achievement. *Journal of Education and Learning, 9*(3), 246–255. https://doi.org/10.11591/edulearn.v9i3.2121

Ikeda, K. (2009). Mixed methods research in education: A case study. *Educational Studies in Japan, 4*(1), 77–90. https://doi.org/10.7571/esj.4.77

Marks, J. (2007). Students and identity theft: A growing concern. *Journal of College Student Development, 48*(1), 1–5. https://doi.org/10.1353/csd.2007.0001

McDaniel, D. (1994). Information security management: Policies and procedures. *Information Systems Security, 3*(1), 1–7. https://doi.org/10.1080/10658989409342585

Nguyen, T. T., Hanafi-Zadeh, R., & Bohlin, E. (2022). ICT and productivity growth: Evidence from developing countries. *Telecommunications Policy, 46*(2), 102–118. https://doi.org/10.1016/j.telpol.2021.102118

Olufemioladebinu, T., Adediran, A. A., & Oyediran, W. O. (2018). Factors influencing the academic achievement of students in Colleges of Education in Southwest Nigeria. *Journal of Education and Human Development, 7*(3), 109–115. https://doi.org/10.15640/jehd.v7n3a12

Ross, J. (1999). Computer security: Principles and practice. *Information Systems Security, 8*(2), 1–7. https://doi.org/10.1080/10658989909342585

Salami, S. O., & Ogundokun, M. O. (2009). Emotional intelligence and academic self-efficacy as predictors of academic performance among senior secondary school students in Oyo State, Nigeria. *International Journal of Research in Education, 5*(2), 164–172.

Shute, V. J., Hansen, E. G., Underwood, J. S., & Razzouk, R. (2011). A review of the relationship between parental involvement and secondary school students' academic achievement. *Education Research International, 2011*, 1–10. https://doi.org/10.1155/2011/915326

Stallings, W. (2008). *Computer security: Principles and practice*. Pearson Education.

Steinmayr, R., Meier, A., Weidinger, A. F., & Wirthwein, L. (2014). Academic achievement. In R. Pekrun & L. Linnenbrink-Garcia (Eds.), *International Handbook of Emotions in Education* (pp. 467–488). Routledge. https://doi.org/10.1093/oxfordhb/9780199756810.013.0108

Tella, A., Tella, A., & Adeniyi, O. (2011). Locus of control, interest in schooling, and self-efficacy as predictors of academic achievement among secondary school students in Osun State, Nigeria. *New Horizons in Education, 59*(1), 25–37.

Tikhonova, N., & Tereshkova, N. (2014). ICT in the classroom: Enhancing student learning. *Procedia - Social and Behavioral Sciences, 152*, 1052–1056. https://doi.org/10.1016/j.sbspro.2014.09.221

Ugwuanyi, C. S., & Okeke, C. I. (2020). Motivation and self-efficacy as predictors of learners' academic achievement. *Journal of Sociology and Social Anthropology, 11*(3–4), 215–222. https://doi.org/10.31901/24566764.2020/11.3-4.197

United Nations Development Programme (UNDP). (2006). *African Information Society Initiative (AISI) e-strategies*. Retrieved from http://www.uneca.org/aisi/nici/

Vu, K., Hanafi-Zadeh, R., & Bohlin, E. (2020). ICT and economic growth: Evidence from cross-country data. *Telecommunications Policy, 44*(2), 101–118. https://doi.org/10.1016/j.telpol.2019.101872

Vygotsky, L. S. (1962). *Thought and language* (E. Hanfmann & G. Vakar, Trans.). MIT Press.

Yin, R. K. (2018). *Case study research and applications: Design and methods* (6th ed.). Sage Publications.