Can indigenous pedagogies improve students' interest in elementary artificial intelligence?

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Abstract

Purpose – This study examines the application of the Culturo-Techno-Contextual Approach (CTCA) in AI education. It aims to address whether the CTCA can increase students' interest in AI, regardless of gender and contribute to the literature on AI education, policy development, instructional design and educational inequalities. The CTCA is a teaching method that integrates indigenous knowledge, context and technology to improve learning outcomes.

Design/methodology/approach – The study employed a quasi-experimental design. One hundred and five participants at the Ghanaian basic education level (38 in the experimental group and 67 in the control group) were selected using purposive and random sampling techniques. Data was collected using the Students' Attitudes Questionnaire (SAQ) and analysed using ANCOVA.

Findings – The findings indicated a statistically significant increase in student interest in artificial intelligence education, favouring the CTCA and GenAI combination over the lecture method. Furthermore, the study revealed no statistically significant differences in interest levels between male and female students, suggesting that CTCA caters to students regardless of gender.

Practical implications – By enhancing the engagement, relevance, and cultural sensitivity of learning, the CTCA effectively fosters student passion for artificial intelligence. This method improves students' interest and enables students to apply their knowledge intentionally in their local environments.

Originality/value – Researchers commonly investigate alternative pedagogical approaches to address learning difficulties. The novelty of this study lies in its application of an Indigenous teaching approach (CTCA) to address students' interest in AI education.

Keywords Culturo-techno-contextual approach (CTCA), Gender gap, Educational inequality, AI education

Paper type Research article

Introduction

Artificial intelligence refers to a machine's ability to simulate and perform tasks that typically require human intelligence, such as logical reasoning, learning and problem-solving

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(Morandín-Ahuerma, 2022). Artificial intelligence is increasingly integrated into various aspects of human life. It outperforms humans in repetitive tasks, reducing fatigue, minimising human error, identifying patterns and accelerating decision-making (Kasianenko and Fedotov, 2022). With these advantages, amongst other reasons, AI is currently being integrated into essential facets of society, including healthcare, banking, manufacturing and education.

Given this increasing dependence on AI, there is a growing need for AI education globally. Various institutions worldwide have been established to award new degrees, producing the necessary human resources to accelerate, manage and secure the current AI revolution (Yeter *et al*., 2024). However, like in many other relevant aspects of life and society, Africa again lags behind the rest of the world (Arakpogun *et al*., 2021).

Even before the current surge in demand for AI education, Africa already lacked the necessary educational infrastructure to keep pace with the rest of the world. This lack of educational infrastructure and relevant systems was made even more apparent during the height of the COVID-19 pandemic (Okebukola *et al*., 2020). Currently, students are not particularly motivated to pursue AI education due to limited accessibility to an enabling environment (Opesemowo and Adekomaya, 2024). Furthermore, schools that continue to teach these AI courses often do so in an abstract manner, presenting these concepts without considering their cultural or societal relevance or importance to students (Engelmann *et al*., 2024).

Outside of these learning difficulties, available research also details that sub-Saharan Africa is also burdened with educational gender inequalities, particularly in STEM and ICT subjects. Elu (2018) asserts that sub-Saharan African gender inequality in STEM is significant, with only 27% of graduates in two broad STEM disciplines. This does not bode well for the continent if it is to meet the UN's SDG 4, which aims to provide quality education for everyone.

In response to these concerns, the Culturo-Techno-Contextual Approach (CTCA) was developed to culturally contextualise materials taught, providing relevance and relatability to students. Available empirical literature details the potency of the CTCA in enhancing student engagement and improving learning outcomes in various STEM (Ademola *et al*., 2023; Awaah *et al*., 2023) and ICT subjects (Armah *et al*., 2024; Gbeleyi *et al*., 2023), irrespective of students' gender (Armah *et al*., 2024), positioning it as a panacea to African educational inequalities. These findings are supported by Yeboah *et al*. (2024), who suggest that pedagogical approaches profoundly influence students' comprehension, highlighting the necessity of proficient educators and Indigenous instructional methods, particularly those originating from Africa, to improve students' academic performance.

Despite this evidence of the CTCA's efficacy in improving students' learning outcomes in the global south, it has yet to be applied to AI education, arguably one of the most abstract aspects of STEM/ICT. This abstraction has served as a stumbling block to Africa's participation in the current AI revolution, necessitating studies that aim to eliminate these abstractions and improve students' learning outcomes.

Further, there is a growing body of literature on the use of AI to improve students' learning outcomes. Gligorea *et al*. (2023) assert that AI/ML integration in e-learning significantly contributes to the personalisation and effectiveness of the educational process, with some studies reporting increased test scores. Aluko *et al*. (2025) also assert that the use of AI in education improves students' access to learning materials. This study aims to contribute to the existing literature on whether AI can be used to augment the CTCA in enhancing students' learning outcomes.

The Culturo-Techno-Contextual Approach

The Culturo-Techno-Contextual Approach (CTCA) is an educational methodology that amalgamates indigenous and cultural frameworks, technology and contextual elements to enhance students' understanding of subjects (Okebukola, 2020). The CTCA aims to integrate curriculum with students' indigenous knowledge, enhancing relatability and mitigating

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learning challenges. It also promotes the cultivation of social skills as learners engage with parents, experts and peers during collaborative discussions (Okebukola, 2020). It cultivates a sense of pride in learners by highlighting Africa's extensive indigenous knowledge system, which remains pertinent in contemporary society.

Integrating African Indigenous Knowledge Systems (AIKS) into higher education can foster appropriate community attitudes and values that promote enduring sustainability (Tetteh *et al*., 2025). AIKS can be acquired through cultural mediums, including folk narratives, songs, theatrical performances, legends, proverbs and myths, and transmitted throughout generations (Gbeleyi *et al*., 2022). Incorporating community knowledge holders into research, pedagogy and education enables students to acquire intergenerational knowledge and acknowledge the competence of elders and other community members.

The CTCA represents a synthesis of culture, technology and context, as depicted in Figure 1.

Further, the CTCA is built on the use of contextual evidence in teaching. Proponents of the CTCA believe that learning is most effective when students can observe concepts or similar iterations in their surroundings, thereby eliminating the need for abstraction. Further, proponents of the CTCA also encourage the use of humour in teaching and learning. Zheng and Gerlofs (2025) also support this position, asserting that humour can have a positive impact on learning environments and relationships. However, it should be used carefully as there are risks of distraction, offence and alienation. The CTCA also relies on the effective use of relevant technology. Technology in education has made it simpler for instructors to transfer information and for pupils to retrieve it and has made the teaching and learning processes more entertaining (Ghory and Ghafory, 2021), making its use part of the CTCA.

Nevertheless, various circumstances may obstruct the execution of the CTCA. The challenges encompass insufficient support and collaboration from school administration, educators and staff; students' absence of internet-enabled devices; a limited timeframe for lessons; learners' lack of motivation to assume responsibility for assigned tasks; teachers' understanding and proficiency in addressing misconceptions when cultural beliefs conflict with scientific explanations and educators' inadequate knowledge of utilising internet-enabled devices.

Theoretical framework – Ausubel's Theory of Advance Organisers

This study's theoretical framework is built on Ausubel's Theory of Advance Organisers. Ausubel's Theory of Advance Organisers posits that structuring new information concerning pre-existing knowledge enhances the acquisition and retention of new material. In his foundational work, "The Use of Advance Organisers in the Learning and Retention of Meaningful Verbal Material," Ausubel (1960) asserted that advance organisers can

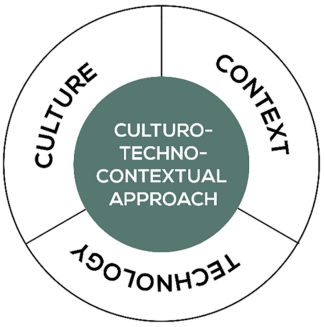

Figure 1. The Culturo-techno-contextual approach (Awaah, 2023)

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significantly enhance meaningful learning. An advance organiser is a framework of pre-existing knowledge provided to learners before introducing new material. It seeks to assist learners in comprehending and retaining new material by linking it to their pre-existing knowledge. This linking process establishes a significant context for new information, enhancing learning and retention (Armah *et al*., 2024).

Indigenous knowledge incorporated into the CTCA functions as schemata or framework, anchoring the newly introduced content and enhancing understanding and learning results. For example, when instructing students on passwords, the educator may reference the well-known Akan idea of *Abusua Agyinahyɛdeɛ*, which means Family/Clan Totems.

In Akan tradition, clan totems are unique lineage, heritage and identity symbols. Each of the eight principal Akan clans (*Abusua*) has a distinctive totem (*Agyinahyɛdeɛ*) symbolising its values and characteristics. These totems are differentiated to prevent confusion and misinterpretation. These totems are esteemed as emblems of power and individuality. Understanding these symbols and their corresponding traditions is essential for obtaining clan privileges (Morgan, 2020). In ICT, passwords function similarly to *Abusua Agyinahyɛdeɛ* (clan totems).

A password is a unique digital identity that grants access to a user's specific digital platforms, much like a clan totem differentiates its members. It ensures safety and defence, protecting the clan's dignity, attributes and traditions. Passwords require knowledge or possession for entry, similar to totems in secret cultures. They must remain confidential, and in Akan tradition, clan totems are protected and passwords are personal, private and confidential.

In this case, the cultural reference of Akan clan totems (*Abusua Agyinahyɛdeɛ*) served as a preliminary framework to educate pupils about passwords, their distinctive attributes, safeguarding measures and the necessity of creating robust passwords that must remain confidential.

Literature review

Teaching methods and students' interests

Studies demonstrate that teaching methods markedly affect students' engagement and academic performance. Interactive and engaging methodologies, including presentation, discussion and inquiry-based techniques, have enhanced student engagement and performance relative to lecture-based instruction (Hafeez, 2021). Educators' training in many pedagogical approaches can improve student performance (Hafeez, 2021). Research indicates that pedagogical methods that engage students, such as interactive and differentiated strategies, are more effective in fostering learning interest than traditional unidirectional lectures (Geletu and Mihiretie, 2024). This is especially pertinent in disciplines such as AI, where student engagement is essential for successful learning (Ginting and Ginting, 2021). Student engagement has been linked to students' learning outcomes (Bos *et al*., 2022). Student engagement ensures that students actively construct understanding through relevant and challenging learning activities (Fernandes *et al*., 2014).

Moreover, using interactive teaching methods has enhanced students' interest in their academic discipline, with elements such as topic engagement and familiarity with interactive techniques favourably affecting class attendance (Vangjel *et al*., 2023). These studies demonstrate that teaching methods can influence students' learning outcomes.

Focusing on the CTCA, it has been found to improve students' achievement (Awaah *et al*., 2023; Armah *et al*., 2024; Ugwuoke *et al*., 2024), reduce anxiety towards learning (Adam *et al*., 2024) and improve critical thinking skills (Gbeleyi *et al*., 2023) and generally perform well in other key students' learning indicators. Studies further demonstrate that students typically rate the CTCA better than the lecture method (Peter *et al*., 2024; Oladejo *et al*., 2023). These findings have been attributed to the CTCA's efforts in removing abstraction and creating a sense of "realness" to the concepts being taught. This improves students' engagement and learning motivation, subsequently improving their learning outcomes. Additionally, the

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pre-lesson assignments allow students to form a schema or scaffolding that enables them to better understand the concepts taught in the substantive lessons.

Regarding the CTCA's impact on gender, available research demonstrates that the CTCA effectively improves students' learning outcomes, regardless of gender. Awaah *et al*. (2022) found that CTCA effectively taught ICT in the global south, improving students' digital literacy and understanding of practical applications, finding no differences between male and female students. These findings have been confirmed in other STEM/ICT fields (Ademola *et al*., 2023; Oladejo *et al*., 2022). These findings have been attributed to the CTCA's ability to remove gender-induced imbalances in student preference. For instance, male students are more likely to pursue STEM/ICT fields, such as engineering and medicine. The CTCA was found to alleviate this barrier through its use of indigenous and contextual examples and applications that removed abstraction and appealed to both genders. These findings are corroborated by other studies that established females tend to perform better where learning is context-based and based on personal preferences, which are core features of the CTCA (Nietfeld *et al*., 2011; Kang *et al*., 2012).

The use of AI in education

Given recent advances in AI development, there have been concerted efforts to study the safe inclusion of AI in education (Dhakal and Devkota, 2024). Dhakal and Devkota (2024) argue that AI can enhance teaching strategies, increase student engagement, and simplify complex subjects for improved comprehension and performance. Kumar (2024) indicates substantial enhancements in student engagement, academic achievement and a decrease in teacher effort inside AI-integrated classrooms. Kumar (2024) further asserts that although AI holds significant promise, it is essential to address fundamental problems for its effective integration into education. Currently, AI in education is utilised in various forms, including web-based intelligent education systems, humanoid robots and web-based chatbots, to enhance the learning experience and quality of education (Chen *et al*., 2020). In online education, AI is used for student evaluation and assessments, retention and dropout forecasting, sentiment analysis, intelligent tutoring, classroom surveillance and recommendation systems. Bouchrika *et al*. (2019) also report that the gamification of learning experiences through the use of interactive AI-driven material enhances students' engagement in the learning process.

In the context of this study, the use of AI would fall under the techno (technology) aspect of the CTCA. Already, the CTCA advocates for the use of technology to access indigenous knowledge through the Internet and other related sources. However, there is growing evidence concerning difficulties in accessing this indigenous knowledge (Lawal, 2020). Aluko *et al*. (2025) also assert that the use of AI in education improves students' access to learning materials. We believe that AI, particularly chatbots like ChatGPT, given their access to vast amounts of training data, may have inadvertently curated indigenous knowledge. Their use could facilitate access and improve students' learning outcomes when utilising the CTCA.

The present study

Previous research has shown that CTCA can improve students' learning outcomes, but it primarily focuses on short-term achievement and anxiety. While some evidence suggests that CTCA can enhance students' interest and engagement in STEM and ICT fields, this is predominantly anecdotal and lacks empirical support. Various researchers have positioned the CTCA as a solution to students' learning difficulties and a strong contender to replace the lecture method. However, obstacles to implementing CTCA in schools include a lack of support from school management, insufficient Internet-enabled devices, a tight time frame, student motivation and inadequate knowledge on how to use these devices.

Various studies have addressed some of these challenges (Armah *et al*., 2024). This study also contributes to the literature by providing an alternative to the native knowledge used in the CTCA. This study also utilised AI to generate stories that mimic African Indigenous knowledge,

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as part of the regular Indigenous knowledge applied to various AI concepts being taught. This forms part of efforts to ensure students can access Indigenous knowledge to use the CTCA.

Thus, this study seeks to apply the CTCA to the AI context and answer the following questions:

(1) How does the Culturo-Techno-Contextual Approach, augmented with AI, influence students' interest in learning AI as compared to the lecture method?

(2) To what extent does the Culturo-Techno-Contextual Approach, augmented with AI, influence students' interest in learning AI across different genders?

Following these questions, the researchers formulate the following null hypotheses:

H_{Oa}. The Culturo-Techno-Contextual Approach, augmented with AI, will not increase students' interest in learning AI

H_{Ob}. The Culturo-Techno-Contextual Approach, augmented with AI, will not increase students' interest in learning AI, regardless of gender

This study will contribute to the literature on AI education, offering an alternative approach to enhancing students' learning outcomes and informing policy development and instructional design. This study will also add to the literature on providing means to reduce educational inequalities and promote female integration into STEM and its adjacent fields. This study will also contribute to the development of the CTCA, assessing whether AI-generated cultural referents will help alleviate students' learning difficulties.

Methodology

Research design

This study employed a quantitative research design, specifically a quasi-experimental design, to investigate the association between the CTCA and students' concerns over ICT learning. The pre-test–post-test non-equivalent groups design was utilised to compare the two groups, with the experimental group receiving instruction through the CTCA and the control group trained using the conventional lecture method. This methodology enabled researchers to simulate a real-world situation, improving the study's external validity (Tetteh *et al*., 2025).

Sample and sampling technique

Two schools served as the control and experimental groups for the study. Distinct schools were chosen for each group to prevent class interaction and safeguard the integrity of the study's conclusions. This research employed a multi-stage sampling method, including purposive and convenience sampling. Purposive sampling was used to choose schools offering artificial intelligence instruction and the relevant grade levels. The schools used in the study were two government schools in Kokrobite, a fishing community located on the outskirts of Accra, Ghana. To ensure that the variation in the groups could be safely attributed to the treatment process, the researchers chose two government elementary schools such that school-level factors, such as teacher quality and resources, were as similar as possible.

Simple random sampling was employed to choose each school's control and experimental classes. The random sample strategy mitigates researcher bias and enhances statistical validity, as participants are not selected based on the researcher's preconceived criteria (Sharma, 2017). The study involved 105 individuals, comprising 67 students in the control group and 38 students in the experimental group.

Participants demographics

Table 1 comprehensively details the demographic features of the participants. The majority of participants were female, comprising 57.14%. Most participants were teens aged 13–16,

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Table 1. Participants demographics

Variable		*n*	%
School	Bortianor MA School (Control)	67	63.81%
	Oshiyie MA School (Experimental)	38	36.19%
Gender	Female	60	57.14%
	Male	45	42.86%
Age	10–12	3	2.86%
	13–16	89	84.76%
	17 and above	13	12.38%
Parental Educational Background	Educated	74	70.48%
	Not-educated	31	29.52%

constituting 84.76% of the study's cohort. Most participants had parents with higher education ($n = 74$, 70.48%).

Research instrument

The researchers created the Students' Attitudes Questionnaire (SAQ), which included a section measuring students' interests (Section D). They developed an initial version that included 10 items of interest to students. This pilot version underwent exploratory factor analysis, which extracted eight items with factor loadings of 0.5 or higher. The reliability was evaluated using Cronbach's alpha, resulting in a value of 0.77. Items from both the original and the validated versions of the instrument are attached as appendices.

The researchers devised two lesson plans based on the curriculum established by the Ministry of Education, one utilising the lecture method and the other employing the CTCA. The researchers instructed students on various introductory concepts in Artificial Intelligence over two weeks, comprising two separate contact sessions for each group.

Treatment procedure

Experimental and control groups were formed from two complete classes from two schools. These classes were selected from different schools to ensure they did not interact with one another, thus avoiding influencing the study's results or undermining its reliability and credibility. The researchers were present at both schools to administer and disseminate the research instrument. They also ensured that all steps in the treatment process were adhered to. However, only one researcher taught both the experimental and control groups, further ensuring similar conditions across both groups (Ugwuoke *et al*., 2025).

Experimental group procedure. The experimental group was instructed to utilise the CTCA 2.0 through the subsequent five phases modified from previous studies on the CTCA (Okebukola, 2020; Ugwuoke *et al*., 2025):

Step 1: Pre-lesson task focusing on cultural customs and online resources relevant to the taught subjects.

The researcher notified students before class of the topic they would be studying. The topic was Introduction to artificial intelligence. Students were required to investigate indigenous knowledge, cultural practices from parents and elders, and other supplementary resources about introducing artificial intelligence (the definitions of various AI concepts, including machine learning, artificial neural networks and associated concepts). This step took about 15 min in class, but students were given a week to complete the pre-lesson assignment.

Step 2: Commencement of collaborative group activity based on the output from Step One.

The in-class lesson officially begins at this point. Students were divided into diverse, coeducational groups after the teacher's opening remarks and asked to present their research on (a) indigenous knowledge, cultural practices and beliefs regarding introductory artificial

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intelligence and (b) summaries of concepts gleaned from online resources. All cultural and Internet research findings had to be compiled and presented to the class by the group leaders. The researcher concluded by discussing their indigenous knowledge and customs relevant to the subject. Ten minutes were set aside for the group leaders to address the class, and twenty minutes were allotted for students to talk among themselves.

Step 3: The lesson advances with elements of humour and practical examples drawn from the school's immediate environment.

At this point, the teacher used relevant examples from the school's surroundings to advance the subject. Students looked at these examples that were pertinent to the subject. The contextual element of the Culturo-Techno-Contextual Approach is the school environment. In their lecture, the instructor used some acceptable contextual humour.

A contextual example used in the classroom: Mobile Money Fraud Detection: As part of efforts to bring banking to the masses, Financial transactions in Ghana are handled mainly by mobile money services such as MTN Mobile Money, Vodafone Cash and AirtelTigo Money. However, fraudsters use phishing, false marketing and identity theft to con consumers. When scammed, one would try to recollect the events leading to the scam to prevent them from happening again. Similarly, machine-learning models learn from patterns in the training data.

Step 4: The lesson advances with humour while connecting the topic to cultural customs and online resources.

The lesson was now progressed by the teacher through the incorporation of cultural practices that were relevant to the topic. The importance of the indigenous knowledge and cultural practices that the groups documented was emphasised to the class in order to guarantee a thorough understanding of the concepts. The teacher also clarified any misunderstandings regarding cultural values. The Indigenous knowledge used by the teacher came in two flavours: natural, existing Indigenous knowledge and AI-generated Indigenous knowledge from ChatGPT.

Examples of human-made indigenous knowledge used during the lesson. Adinkra Symbols: Adinkras are pictorial symbols or ideographs embody notions and aphorisms derived from the Akan people, the predominant ethnic group of contemporary Ghana and the Ivory Coast in West Africa. While numerous narratives exist regarding the genesis of Adinkra symbols, their cultural significance and meaning remain undisputed. The Adinkra symbols serve not merely as ornamental elements on textiles, structures or decor but encapsulate ancient traditional wisdom regarding life, philosophical concepts and environmental concerns. A multitude of Adinkra symbols possess meanings associated with proverbs, while certain symbols illustrate historical events, human conduct and attitudes, animal behaviour, plant life and the shapes of objects. Just as Adinkra symbols convey African indigenous knowledge by recognising patterns, machine learning algorithms also learn by identifying data patterns. Examples of adinkra symbols are presented in Figure 2.

Kente Weaving: Kente denotes a Ghanaian fabric composed of hand-woven strips of silk and cotton. Historically, the cloth was donned by the Asante, Akan, and Ewe peoples. Asante oral tradition asserts that it originated from Bonwire in the Ashanti Region of Ghana. In contemporary Ghana, the utilisation of kente cloth has proliferated to celebrate significant events, and kente brands, spearheaded by master weavers, are in considerable demand. Kente weaving involves learning and perfecting patterns in cloth. Similarly, ML models learn patterns and perfect them with continued use. An example of kente weaving is presented in Figure 3.

Examples of indigenous knowledge created with ChatGPT.

(1) *Deep Learning mimics the traditional Ghanaian apprenticeship system, where artisans (e.g. blacksmiths and carpenters) gain expertise through years of hands-on experience. Like AI deep learning models, proverbs capture complex insights from generations of observation.*

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DENKYEM	*"crocodile"*	**adaptability**
DUAFE	*"wooden comb"*	**beauty, hygiene, feminine qualities**
DWENNIMMEN	*"ram's horns"*	**humility and strength**
EBAN	*"fence"*	**love, safety, security**
EPA	*"handcuffs"*	**law, justice, slavery**
ESE NE TEKREMA	*"the teeth and the tongue"*	**friendship, interdependence**
FAWOHODIE	*"independence"*	**independence, freedom, emancipation**
FIHANKRA	*"house/compound"*	**security, safety**
FOFO	*"a yellow-flowered plant"*	**jealousy, envy**
FUNTUNFUNEFU DENKYEMFUNEFU	*"siamese crocodiles"*	**democracy, unity in diversity**
GYE NYAME	*"except for God"*	**supremacy of God**
HWEMUDUA	*"measuring stick"*	**examination, quality control**
HYE WONHYE	*"that which cannot be burnt"*	**imperishability, endurance**
KETE PA	*"good bed"*	**good marriage**

Figure 2. Adinkra symbols

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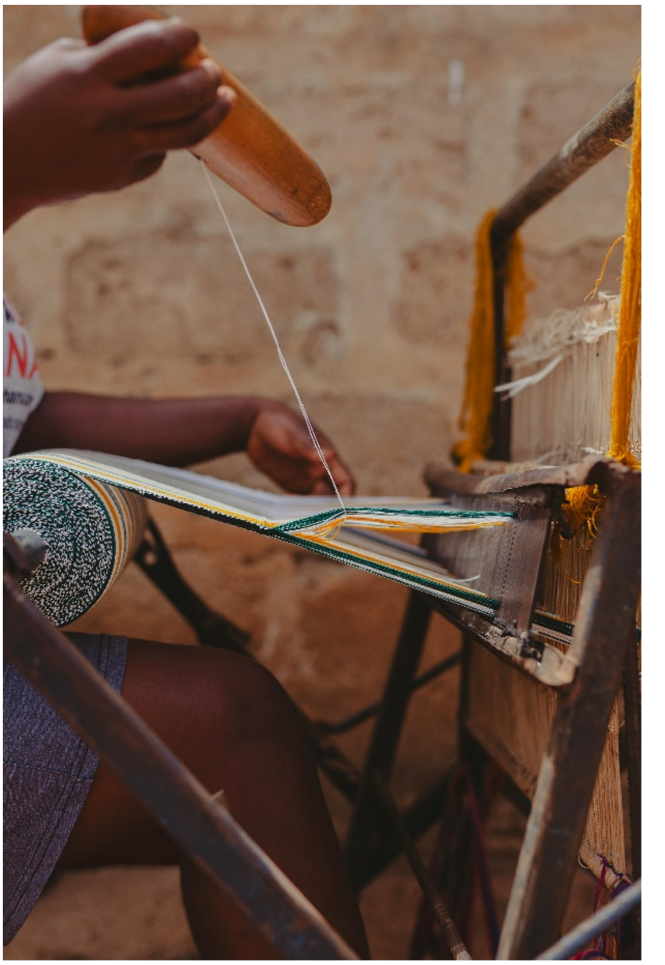

Figure 3. Kente weaving

(2) *Games like Oware (a strategic board game) and Ampe (a rhythm-based game) encourage learning through play, similar to gamification in AI. These traditional games teach strategy, coordination and decision-making, just as gamification enhances learning and motivation in AI applications.*

Steps 3 and 4 occurred somewhat simultaneously and together formed the bulk of the lesson, using about 1 h.

Step 5: After the course, a summary is dispatched to students by WhatsApp or SMS.

Upon concluding the class, the instructor disseminated a summary of the course to the students via WhatsApp, Telegram or any other messaging application with which they were familiar. This was transmitted via their parents.

This formed one session. Such sessions were conducted over two consecutive weeks, comprising two teaching sessions per week, each lasting approximately 1 h 45 min, followed by a final meeting for administering the research instrument. Both the control and experimental groups received equivalent instructional time to eliminate any further discrepancies.

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Control group procedure. The control group was taught "Introduction to Artificial Intelligence" using the lecture method. The following steps were used to that effect. Before the researchers met the students for the lesson, their teachers informed them of the next lesson, "Introduction to Artificial Intelligence," and that the lesson would be taught by the researchers.

Step 1: The teacher (teaching researcher) introduced "Introduction to Artificial Intelligence" and the students' definitions of artificial intelligence.

Artificial intelligence (AI) is a technology enabling computers and machines to emulate human learning, comprehension, problem-solving, decision-making, creativity and autonomy.

Step 2: The teacher further explained the types of artificial intelligence.

The discussed types were:

Artificial narrow intelligence (ANI): Commonly referred to as weak AI, this kind of artificial intelligence is engineered for particular functions, like speech recognition, autonomous vehicles and streaming services. It is utilised in healthcare, finance, manufacturing, customer service, security and data science, aiding in data analysis and classification.

Artificial general intelligence (AGI) seeks to execute cognitive activities akin to human capabilities, adapting to novel circumstances across diverse domains such as robotics, healthcare and transportation. Specialists in artificial intelligence are currently endeavouring to attain General AI.

Artificial superintelligence (ASI), a theoretical construct not yet realised, is discussed for its capacity to address intricate challenges, although apprehensions regarding associated risks and potential dangers persist.

Step 3: The teacher explained introductory concepts, including artificial neural networks and their types. Key concepts addressed included machine learning, artificial neural networks, deep learning, virtual reality and mixed reality.

Step 4: The lecturer finally listed some use cases for artificial intelligence in various facets of society, including:

(1) Healthcare: Drug Discovery, Diagnosis and Treatment

(2) Transportation: Autonomous Vehicles and Traffic Control

(3) Entertainment: Suggestions for Customised Content and Gaming.

Throughout the lecture, students were free to ask questions at any time.

The control group sessions were also conducted over two weeks, just like the experimental group, with each session lasting approximately 1 h and 45 min to eliminate any disparities (Figure A1).

Data collection and analysis procedure

The researchers liaised with teachers to determine the best time for data collection. Furthermore, their assistance was necessary in forming heterogeneous groups of students for the experimental group. A welcoming environment was created, and attestation statements and questionnaires were distributed to ensure student participation. The Students' Attitudes Questionnaire (SAQ) was administered to establish pre-treatment levels, followed by treatment procedures for both groups: the CTCA for the experimental group and the lecture method for the control group. The post-treatment levels were established using the SAQ. The cross-sectional data collected were analysed using ANCOVA analysis in SPSS, as it allows for various parametric analyses (Awaah *et al*., 2024). In using the ANCOVA analysis, the researchers conducted some preliminary tests to ensure the validity of the results. These were the Kolmogorov–Smirnov and Shapiro–Wilk tests, which were used to test normality. Levene's test was used to measure the variances among the groups.

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Considerations for ethics and privacy

Ethical approval for the study was granted by the Lagos State University Research Ethics Committee (LASU-REC) through the Africa Centre of Excellence for Innovative and Transformative STEM Education (ACEITSE) on 8th June, 2023. The institutions were notified through official introductory letters before undertaking the study. Respondents were assured that their submitted information would be treated cautiously and with utmost confidentiality. Further approval was sought from the relevant school parent and teacher bodies before the treatment and instruments were administered. Students could withdraw from the study at any time without reason. The data collected was only used for scholarly reasons.

Findings

This section presents the study's findings presented in tables and summarised in the paragraphs that follow.

Table 2 displays the averages for both the control and experimental groups. A higher mean indicates higher students' interest. Before the implementation of the treatment, the male students and the control group exhibited a higher interest in artificial intelligence. Subsequently, following the administration of the treatment, the experimental group exhibited superior interest compared to the control group. However, male and female students exhibited comparable interest levels (see Table 2).

The null hypotheses developed were tested using ANCOVA, which requires testing normality and homogeneity of variance to validate its findings. The Kolmogorov–Smirnov and Shapiro–Wilk tests yielded non-significant results, suggesting normality. Levene's test was also non-significant, signifying equal variances among the groups. Given these results, the researchers applied the ANCOVA test.

The ANCOVA analysis reveals a statistically significant difference in the interests of students taught using the CTCA as compared to those taught using the lecture method in artificial intelligence [$F(1, 100) = 12.74$; $p < 0.05$] (refer to Table 3). Following this result, the null hypothesis H_{Oa} was rejected.

The partial eta squared value for the effect of the treatment groups, accounting for pre-treatment scores as a covariate, was calculated to be 0.113. This suggests that about 11.3% of the variance in post-treatment ratings can be attributed to the interplay between the treatment groups and pre-treatment scores (see Table 3). This indicates a moderate effect size, suggesting that the CTCA has a substantial influence on student achievement.

The ANCOVA analysis also reveals no statistically significant difference in the interests of male and female students in artificial intelligence [$F(1, 100) = 0.82$; $p > 0.05$] (refer to Table 3). Furthermore, the interaction term between groups (teaching methods) and gender was not statistically significant [$F(1, 100) = 3.14$; $p > 0.05$], indicating that the effect of the CTCA on students' interest does not vary by gender. Following this result, the null hypothesis H_{Ob} was rejected.

Table 2. Pre- and post-test mean and standard deviation scores

			Mean	Standard deviation
Pre-test	Group	Control	23.81	4.05
		Experimental	22.82	4.35
	Gender	Female	22.96	4.23
		Male	23.82	4.12
Post-test	Group	Control	23.21	4.52
		Experimental	26.37	3.60
	Gender	Female	24.31	4.17
		Male	24.38	4.71

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Table 3. Analysis of covariance (ANCOVA) on post-test scores of experimental and control groups with pre-test scores as covariate

Dependent variable: Post-test						
Source	Type III sum of squares	df	Mean square	F	Sig	Partial eta squared
Corrected Model	302.013[a]	4	75.503	4.266	0.003	0.146
Intercept	1877.124	1	1877.124	106.055	0.000	0.515
Pre-test	0.611	1	0.611	0.035	0.853	0.000
Group	225.505	1	225.505	12.741	0.001	0.113
Gender	14.465	1	14.465	0.817	0.368	0.008
Group * Gender	55.495	1	55.495	3.135	0.080	0.030
Error	1769.949	100	17.699			
Total	64,341.000	105				
Corrected Total	2071.962	104				

Note(s): [a]*R* Squared = 0.146 (Adjusted *R* Squared = 0.112)

Discussion of results

This study demonstrates that the Culturo-Techno-Contextual Approach (CTCA) significantly enhances students' interest in learning about AI. This finding largely corresponds with existing literature expressing the CTCA's efficacy in improving students' learning outcomes (Adam *et al*., 2024; Awaah *et al*., 2023; Armah *et al*., 2024; Gbeleyi *et al*., 2023; Oladejo *et al*., 2023; Peter *et al*., 2024; Ugwuoke *et al*., 2024). This is a valuable addition to the growing body of research that supports culturally responsive and contextually grounded teaching methods. The CTCA provided an engaging, immersive, and relevant learning experience by utilising students' indigenous knowledge systems and incorporating real-life cultural references. This approach worked equally well for both genders.

One of the main findings of this research is that indigenous knowledge, such as Adinkra symbols and the kente weaving technique, can be utilised to make abstract concepts, like the iterative process in machine learning, easier to understand. These culturally relevant pre-lesson tasks served as advance organisers, linking new information to familiar settings. This supports Okebukola's (2020) claim that utilising what students already know may help them understand and remember things better. Kpaji and Ibrahim (2015) also advocate for including indigenous knowledge systems in the classroom. This method can make science classes boring and hinder students' understanding of fundamental scientific ideas, techniques and principles. This study takes it a step further by applying that idea to AI education, a new area of study in African schools.

Furthermore, CTCA contextualises learning in ways that appeal to students' cultural and everyday realities, helping to reduce the feelings of alienation sometimes experienced in STEM education. This contextualisation allowed students to observe how relevant artificial intelligence is for their personal lives and communities (Abdulhadi *et al*., 2024; Okigbo and Oshabaonuh, 2024). The method also leverages students' current technological knowledge, simplifying complex AI concepts. This familiarity fosters a positive attitude towards learning artificial intelligence and helps alleviate the anxiety commonly associated with acquiring new technical knowledge (Abdulhadi *et al*., 2024). Even without technology, Armah *et al*. (2024) found that the right blend of cultural and contextual adaptations of the course content improves students' learning outcomes. This study also demonstrates that African Indigenous Knowledge is a powerful tool for enhancing students' learning outcomes.

Furthermore, the study also demonstrated the efficacy of AI in improving students' learning outcomes when used in conjunction with the CTCA. The study's findings indicate that students had an easier time accessing the relevant indigenous knowledge when using AI (Aluko *et al*., 2025). Using GenAI to access the relevant indigenous knowledge, the wall of

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abstraction was removed, allowing students to understand the concepts better. This may have also been responsible for the increase in interest.

The findings indicated that the CTCA not only heightened interest in AI but also mitigated gender discrepancies often seen in STEM/ICT participation. This study demonstrated that although males are generally better at STEM/ICT fields (Cheryan *et al*., 2017), females tend to close that gap in settings that prioritise context over the robotic abstraction typically attributed to STEM/ICT fields (Nietfeld *et al*., 2011; Kang *et al*., 2012). Both male and female students exhibited heightened engagement, indicating that contextualising information and promoting cooperation in mixed-gender groups contribute to equity. This corroborates other research (Awaah *et al*., 2022; Ademola *et al*., 2023; Oladejo *et al*., 2022; Gbeleyi *et al*., 2023), while providing new evidence that the CTCA may serve as an effective instrument for promoting gender equality in emerging technology education.

Conclusions and implications

The study aimed to address the following question: (a) How does the Culturo-Techno-Contextual Approach affect students' interest in learning AI compared to the lecture method? (b) To what extent does the Culturo-Techno-Contextual Approach influence students' interest in learning AI across different genders?

The results showed a statistically significant increase in student interest in learning artificial intelligence, supporting CTCA over the lecture method, when augmented with AI. These results position the CTCA as a valuable teaching tool for increasing participation in artificial intelligence courses, particularly when used in conjunction with AI. Moreover, the study revealed no statistically significant variation in interest levels between male and female students, suggesting that the efficacy of this union (CTCA and AI) is served by students regardless of gender. The findings provide some preliminary evidence that the CTCA's effectiveness in generating interest in artificial intelligence is not gender-dependent, supporting its inclusive and generally prosperous teaching value. However, this is not conclusive as further evidence in other contexts and situations is required. Based on this study, we believe that the CTCA, when used in conjunction with GenAI, provides a valuable approach to enhancing student enthusiasm for artificial intelligence by making learning more engaging, relevant, and culturally sensitive.

The study's results also have implications for the use of AI in education. The study demonstrates that AI can be used as a support tool in indigenous-based teaching methods to enable students' easy access to indigenous knowledge. The study's results also indicate AI's ability to create personalised, student-centred learning environments promoting gender equality and other forms of equality in education.

Limitations of the study

The research focused on junior high school students in rural settings, challenging generalisations to other educational levels or settings. The study employed cross-sectional data and a quasi-experimental design, which limited its comprehensive understanding of artificial intelligence. It also focused on introductory concepts, rather than more complex ones and overlooked connections with other educational technologies, such as learning management systems. In addition, the study focused on short-term interest given the relatively limited time allotted for the intervention. Additionally, there is concern that unintentional curation of indigenous knowledge may occur, particularly amid concerns that GenAI is colonising knowledge and language.

Recommendations for further research

Further research should investigate CTCA's efficacy in relation to other demographic factors, including age, instructor expertise and instructional competency, which may impact its effectiveness in enhancing student engagement and learning outcomes. Although this study

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demonstrates the CTCA's success in a controlled setting, it is essential to assess whether the CTCA's effectiveness extends to all relevant demographic groups and learner profiles. This will help in accessing a more comprehensive picture of its full-scale adaptability.

Future studies could also investigate the long-term effects of CTCA on students' learning outcomes in AI and other STEM domains, therefore evaluating whether the method generates continuous interest and competency after the lesson. Short-term cross-sectional studies like this only measure students' initial interest; a longitudinal study would measure enduring and persistent interest from students, which is currently not available in the literature. There is also a need to create guardrails, particularly amid concerns that GenAI is colonising knowledge and language.

Additionally, the current literature primarily focuses on students' viewpoints; however, for a holistic implementation of the CTCA, it is necessary to understand the perspectives of teachers, administrators and policymakers. This will help understand how the CTCA can be deployed at scale.

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Appendix 1

Table A1. Pre-validation list of items in Interest Construct

1. I think it's cool when computers can do smart things like humans
2. I find it interesting to learn how AI helps create smart devices and technology
3. I like learning about AI used in voice assistants and recommendation systems
4. I'm curious to know how robots and chatbots can talk and respond like people
5. I like exploring different types of AI, like machine learning and robotics
6. I enjoy coding and creating AI models and algorithms
7. I like talking about AI with friends and family to know what they think
8. I look for books or videos to learn more about AI basics
9. I believe AI can help solve real-world problems and is important for the future
10. I enjoy doing AI-related activities and projects in school or at home

Appendix 2

Table A2. Post-validation list of items in Interest Construct

1. I believe AI can help solve real-world problems and is important for the future
2. I enjoy doing AI-related activities and projects in school or at home
3. I find it interesting to learn how AI helps create smart devices and technology
4. I'm curious to know how robots and chatbots can talk and respond like people
5. I like learning about AI used in voice assistants and recommendation systems
6. I like exploring different types of AI, like machine learning and robotics
7. I like talking about AI with friends and family to know what they think
8. I look for books or videos to learn more about AI basics

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Appendix 3
Images from the treatment process

(a)

(b)

Figure A1. (a) Experimental group treatment in session, (b) Control group treatment in session

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