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**Author(s):** Sanusi, Ismaila Temitayo; Olaleye, Sunday Adewale

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# An Insight into Cultural Competence and Ethics in K-12 Artificial Intelligence Education

Ismaila Temitayo Sanusi  
School of Computing  
University of Eastern Finland  
Joensuu, Finland  
ismaila.sanusi@uef.fi

Sunday Adewale Olaleye  
School of Business  
JAMK University of Applied Sciences  
Jyväskylä, Finland  
sunday.olaleye@jamk.fi

**Abstract**—As artificial intelligence education (AI) continues to be integrated into the mainstream educational system across countries, cultural competence and ethical considerations should be emphasized to ensure effective AI learning. Literatures has established that integrating elements of cultural competence within technology mediums has helped students understand difficult topics from computer science concepts learned in class. It is also argued that student with an ethical orientation of AI education is more likely to learn more about impacts and implications of AI. Hence, this study was conducted to understand how students' cultural competence, and ethics combine to influence AI content. We surveyed Nigerian high school students after an experimental teaching session. A total of 596 students provided useful responses for the analysis that was done using WarpLS software. We performed structural equation modelling to understand the relationship among the variables utilized in the study. The result shows that cultural competence and ethics significantly influence AI content. This study's results further shows that the association between ethics of AI and AI content has the highest predictive value which emphasises the vital role of ethics in AI learning. This study also tested school location differences in the research model and discovered that urban students' perception is higher than their rural counterpart on the adopted variables in relation to AI content. Overall, the results suggest that stakeholders and educators should emphasize cultural elements and humanistic thinking as well as ethical considerations in the design of AI content and instructional materials. We discuss the findings and propose future directions.

**Keywords**—AI education, high school, cultural competence, ethics, Africa

## I. INTRODUCTION

The need for teaching and learning artificial intelligence (AI) from pre-school to secondary school has been heightened in recent times [1][2]. This is connected to the ubiquitous nature of AI that continue to permeate the society through various devices and technological appliances. While AI for K-12 initiatives are mostly promoted in the developed world, developing countries especially Africa also need to develop human resources with AI skills to meet new jobs needs and foster local AI innovations. In order to achieve this, content developed could consider cultural issues including traditions and customs [3] and ethical concerns. Especially, that previous research has identified cultural barriers including language, relevance, and connecting methodology to a sense of place as hindrances to Science, Technology, Engineering, and Mathematics (STEM) careers [4][3]. More so, researchers have acknowledged that societal and ethical drawbacks are posed by AI applications despite its numerous benefits [5]. It is therefore critical to take action toward addressing them. To

develop AI competencies the young citizens need to overcome the 4<sup>th</sup> industrial revolution, the role of cultural competence and ethical concerns needs to be emphasized in curriculum development. This claim is supported by [6] that specified teaching and learning should spotlight relevant cultural competencies.

Globally, AI for K-12 is still emerging such that despite several curricula [7][1][2][8] developed across regions, only eleven countries have Government-endorsed K-12 AI curricula [9]. Four other countries were reported to have governmental K-12 AI curricula under development while there is no evidence of curriculum designed in African countries. This is also confirmed by a recent study [10] that gathers the pre-conceptions of teachers on teaching machine learning in African schools. The lack of AI curriculum designed for African context presents a gap since the most effective way to ensure AI learning in schools is to mainstream AI competencies development in national curriculum. While there is possibility to adopt existing curricula, evidence suggests that present curricula are difficult to adjust to other contexts [11][12]. More so, that Africa is characterized with heterogeneity in culture and custom.

We understand that Africa as a continent is not monolithic, with several countries and different needs for AI. Due to its multicultural nature, the authors therefore do not argue that the sample utilized in this study are representative of the vast continent. Hence, this study was conducted to understand how students' cultural competence, and ethics combine to influence their learning of AI content in Nigerian high schools. This study also examines the assumption of disparate digital literacy, in this case AI learning between rural and urban students. This paper introduces AI K-12 education and the study context in the first section. Section two briefly examined previous literature on cultural competence and ethics and formulated hypotheses that guided the study. Section three detailed the methodology employed and section four shows the data analysis and result. Section five discusses the findings and concludes the paper with limitations and recommend future studies.

## II. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

This section examined previous literature on cultural competence and ethics and formulate hypotheses that guided the study. The research model is shown in Fig 1.

### A. Cultural Competence (CC)

According to [13], incorporating cultural competence in computer science curriculum will educate students with a

better understanding of diversity, equity, and inclusion issues. The author further stressed that it also benefit the retention of marginalized students. Cultural competence can be understood as an awareness for one's own cultural identity and views about difference. In this study, cultural competence is concerned with students' perceived understanding of cultural backgrounds and humanistic ideas to correctly understand the value of AI. Since studies showed the impact of cultural competence in understanding of computing topics and concept [14], we anticipate that it could influence AI content. Therefore, we hypothesize thus:

H1: Cultural competence positively affects AI content

### B. Ethics of AI (EAI)

Ethics has been recognized as an important aspect to consider in AI content. Long & Magerko [15] identified ethics as a competency centered on how AI should be used. This is also established by [16] that AI applications can impact society in both positive and negative ways. The ethical questions around the use of AI can be linked to privacy, discriminations, and bias in AI [17]. An example includes [18] that created interactive art experiences that spur participants to question the implications of technologies like facial recognition. Skirpan, et al. [19] also introduced activities on Facebook use of face recognition technology to identify the faces of untagged people to spur discussion on teaching ethics in CS class. Since AI ethics will consider imagining future AI and its implications as well as discussing and reflecting on AI representations in the media to spur learner's to critically examine algorithms and bias [15], we believe this will have impact on AI content and learning of AI. We therefore hypothesized that:

H2: Ethics will positively affect AI content.

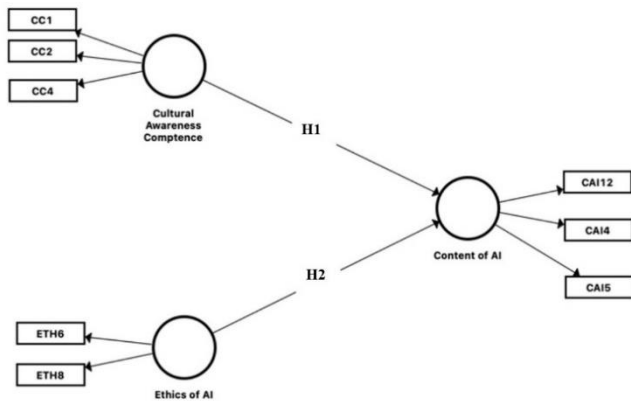


Fig. 1. Research Model

### C. Content of AI (CAI)

The content to be learned remain a critical element and a significant role in students learning. The content to be learned must establish relevance. The relevance could be established through showing how theory can be applied in practice, establishing relevance to local cases and relating material to everyday applications [20]. The learning material could influence learners' ability to comprehend and retain information. The content of AI discussed in this study include knowledge of programming, knowledge of image processing, natural language processing, robots, development of AI, machine learning and AI ethics. We believe that for K-12

students to be motivated to learn AI and understand AI concepts effectively, the content must be well planned and all inclusive. The inclusiveness refers to educational stakeholders including the students which is the focus of this study. This study attempts to understand the influence of cultural and ethical competence in AI content.

## III. METHODOLOGY

This section detailed the method utilized in the study. This includes the study approach, demography, measurement model and analysis.

### A. Study Questionnaire

This study used quantitative methodology and sample the population of high school students introduced to an hour session on AI lesson in Nigeria. This study began with search for applicable measurement in the literature and the scales for cultural competence, AI ethics and AI content were found applicable to the research objectives. Likert Scales questions with 5-point measurement that captures strongly disagree (1) and highly agree (5) were adapted from the existing literature on the explanatory variables [21]. Some descriptive questions were also included in the questionnaire. Orange data mining software was used for the data cleaning process and analysis of the descriptive data while SmartPLS version 3.3.3 was used to conduct the measurement and structural equation modelling. The items adapted from the study of [21] are detailed below:

CAI refers to content of AI. The items were "Acquiring programming knowledge is beneficial to me; Intelligent robots are useful in my life; Knowledge of AI is crucial in understanding AI". EAI refers to the ethical concern related to AI technologies. The items were "AI will one day replace human beings; AI may also have negative impacts on my social life". CC measures to students' perceived understanding of cultural backgrounds and humanistic ideas in an attempt for students to correctly understand the value of AI intelligence. The items were "I understand the various cultural backgrounds and activities in my life; I understand various kinds of humanistic ideas; I am capable of analyzing emotions".

### B. Demography Data Analysis Result

This study sampled 596 high school student in Nigeria. Based on an introductory AI lesson session to familiarize the basic content concepts to the K-12 learners, we probed into the cultural competence and ethics to understand their influence on AI content. To establish relevance, we used examples relating to everyday applications of the students. Examples include speech detection while interacting with speech-based personal assistant services or identifying faces, and when tagging photos on social media. The session utilizes approximately 10-minute short videos on teaching AI and ML as a point of departure. The specific short videos were introduced due to the simplification of their contents which provides practical examples that allows novices to grasp the concept of AI. Opening the session with the video, the researchers created an inclusive discussion environment which enable the students to give examples of AI applications such as in social media and intelligent devices they use on daily basis. The students' response suggests that they are aware of AI applications, but they could identify some of them at the end of the teaching session. Hardcopy survey was immediately distributed after the

sessions and were retrieved for analysis. Table I contain the demography details of the respondents.

TABLE I. DEMOGRAPHIC DETAILS

Variables	Classification	Frequency	Percentage%
Gender	Male	290	48
	Female	306	52
Age	13-15	235	37
	16-18	352	62
	>18	9	1
Grade level	Grade 10	161	27
	Grade 11	125	21
	Grade 12	310	52
School settings	Urban	480	78
	Rural	116	22

There is slightly difference in the number of students in relation to gender sampled in this study. Females constitute 52% and their male counterpart is 49.8%. For age, the students age ranges between 16-18 years (62%) mostly. Most of the students that participated are in the final grade of high school (52%). Finally, most (78%) of the schools sampled are located in urban area.

### C. Measurement Model Result

This study examined the measurement and structural quality of the factors utilized with their items. For example, the factor loadings were examined based on the proposition of [22], All the items loaded well under each factor with the lowest (0.666) and maximum loading (0.858). All the loadings are higher than the recommended threshold. Also, composite reliability results show the reliability of the measurement utilized and the values higher than the threshold of 0.7 [23]. Concerning the Average Variance Extraction (AVE), the results show acceptable criterion of 0.50 as proposed by [24]. The data analysis in this study demonstrates discriminant validity because the constructs used in this investigation, which were purportedly unconnected, are in fact unrelated. Further, the Variance Inflation Factor (VIF) shows that there are no issues of collinearity (See Table III).

TABLE II. STANDARDIZED LOADING AND CONSTRUCT RELIABILITY WITH AVE

	Coefficient	f square	CR	AVE	CAI	CC	EAI
CAI			0.749	0.50	0.706		
CAC	0.219	0.055	0.778	0.539	0.299	0.734	
EAI	0.314	0.112	0.747	0.599	0.370	0.256	0.774

CR: Composite reliability; AVE: Average variance extracted; CAI: Content of AI; CC: Cultural competence; EAI: Ethics of AI

TABLE III. CORRELATIONS AMONG LATENT VARIABLES

	CAI	CC	EAI	VIF
CAI1	0.666			1.085
CAI4	0.719			1.116
CAI5	0.733			1.157
CC1		0.719		1.252
CC2		0.748		1.188
CC4		0.735		1.135
EAI2			0.858	1.045
EAI3			0.680	1.045

CAI: Content of AI; CC: Cultural competence; EAI: Ethics of AI; VIF = Variance Inflation factor.

## IV. RESULT

The proposed hypotheses were tested with SmartPLS through Bootstrapping and the variables responsible for the content of AI were identified and confirmed. Concerning the content of AI, cultural awareness competence -> content of AI (Beta = 0.22, t = 5.36, p < 0.001) and ethics of AI (Beta = 0.31, t = 7.40, p 0.001) are significant predictors. All the hypotheses (H1 and H2) are accepted. This study's results show that the association between ethics of AI and content of AI has the highest predictive value (Table IV). Content of AI explained 17.9 percent of variance in cultural awareness competence and ethics of AI (see Figure 2). Multigroup analysis results also shows that the K-12 students' perception on cultural awareness competence and content of AI is higher with the urban students than the rural students and similarly the ethics of AI and content of AI perception of the K-12 students is higher for the urban students than the rural students. Hypotheses H3 and H4 shows difference the K-12 students' perception of content of AI and were accepted (Table V).

TABLE IV. STANDARDIZED PATH COEFFICIENT FOR TESTED MODEL

Hyp	PC	Original Sample (O)	SD	T Statistics ( O/STD EV)	P Values	Results
H1	CC->CAI	0.219	0.041	5.356	0.000	Accepted
H2	EAI->CAI	0.314	0.042	7.403	0.000	Accepted

Hyp= Hypothesis, PC=Path Coefficient, SD= Standard Deviation

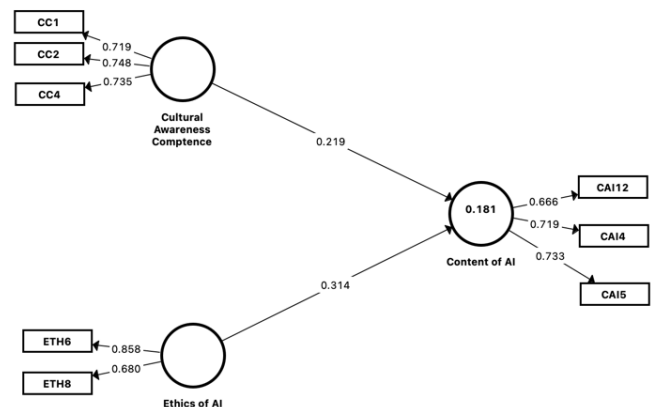


Fig. 2. Tested research model

TABLE V. MULTIGROUP ANALYSIS TABLE

Hyp	Bootstrapping Results	t-Value (Rural)	t-Value (Urban)	p-Value (Rural)	p-Value (Urban)	Results
H3	CAC->CAI	2.534	4.643	0.011	0.001	Accepted
H4	EAI->CAI	2.307	6.515	0.021	0.001	Accepted

PC=Path Coefficient, SD= Standard Deviation

## V. DISCUSSION

Considering the importance of competencies learners need to effectively interact with and learn AI to succeed in the 21st century, we aim to understand how students' cultural competence, and ethics combine to influence their learning of AI. In this regard, the presented research aims at advancing the present knowledge on role of cultural competence in K-12 AI education and ethical considerations, in fostering students understanding of AI. While these has not been an area of much scrutiny globally, we considered high school students in Nigeria in attempt to initiate the discussion around K-12 AI in African context.

To enact AI education in schools, instances within the curricula covering the topics should be identified and emphasized. However, to develop a curricular material, all educational stakeholders including the students should be involved to ensure an inclusive process. Even though adopting a new subject as a curricular material requires the analysis of the state's policy and future needs. This study gathers students' perspectives on the influence of cultural competence and ethics on AI content. While this is not an end in itself, it is a part of the inclusive process where other stakeholders would be included to verify and identify other competencies need for AI learning effectively especially in the context in focus.

It was found that cultural competence and ethics significantly influences AI content while ethics is the highest predictor of AI content. The significance of cultural competence highlights the importance of considering cultural elements in AI content for effective AI learning. This could aid the learners' realization of AI value. A recent study identifying essential competencies of a new subject for school curriculum asserts that cultural competence is central to skill development [6]. Our result is in tandem [3] that emphasizes content considering cultural issues including elements such as traditions and customs are important to teach students to be successful problem solvers and workforce literate in computational and data science. Isaac, et al. [14] also established that integrating elements of cultural competence within technology mediums has helped students understand difficult topics, including building of animated artefacts from computer science concepts learned in class. According to [25], AI has the potential to be as impactful in Africa as it is in other regions of the world, but the unique context of Africa will influence the depth and breadth of the impact.

Ethics significance in AI content as shown in our study confirms the vital role of ethics in AI education. This can be corroborated with [19] study which found out that infusing ethical dilemmas in the curriculum can amplify interest. Ali et al., [26] also stressed that next generation of technologists must be trained to understand the technology ethical and societal impact and not to only see AI as a tool. Few AI ethics curriculum presently exist [27]. AI content design considering ethical implications, taking cognizance of cultural elements in Nigeria could be developed. The AI ethical content may adopt a culturally responsive approaches to contextualize AI as utilized by [12]. This will be important for young children to understand the implications of AI technologies they interact with in their daily life.

The disparate perception was shown between rural and urban students on cultural competence, ethics and AI content. Previous works revealed conflicting results about the difference between urban and rural groups of students in

digital literacy. For instance, a recent study by [28] suggests that school location may not be a defining explanatory element in the variation of digital literacy among students. In contrast an earlier research by [29] showed that learners in schools located in rural provinces have better IT literacy achievement than ones studying in major cities. Suh et al. [29] asserted that the surprising result was because of a significant technology investment by governments in those disadvantaged provinces. Hence, the issue of school location influence on the level of students' digital literacy is an ongoing discussion that requires more research. This study specifically examines the rural-urban student perception gap of cultural and ethical competence influence on AI content. This is important, as it is an attempt to address equity issue recognised by [30] which reveals that there is a great dichotomy between urban and rural schools and between public and private schools in ICT implementation in Nigerian Education.

In conclusion, this study investigated the factors that influenced AI content for effective AI learning and discovered that integrating cultural competence and ethical considerations in AI curricula material results is impactful. Additionally, research has indicated school location effects on digital literacy [28]. This study tested school location differences in the AI research model and discovered that urban students' perception is higher than their rural counterpart. Overall, the results suggest that stakeholders and educators should emphasize cultural elements and humanistic thinking as well as ethical considerations in the design of AI content and instructional materials. This will motivate students to effectively learn AI and develop AI skills to meet new jobs needs and foster local AI innovations.

### A. Limitation and future research

While this study provide insight into cultural competence as a whole in a culturally diverse context, future research could adopt Inventory for Assessing the Process of Cultural Competence (IAPCC-R) [31]. Using IAPCC-R will result in measuring the five cultural constructs of the model (cultural desire, cultural awareness, cultural knowledge, cultural skill and cultural encounters) in relation to AI content. Adopting this instrument will generate more insights to fully understand the role of cultural competence in AI education. Future studies should consider gathering the teachers perspective to corroborate the findings from the student. A qualitative methodology approach could be considered by future researches to complement the technique implemented in this study to better understand the aim under scrutiny.

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