AWARENESS, UNDERSTANDING AND INTEGRATION OF AI ETHICS INTO THE CURRICULUM OF UNDERGRADUATE INDUSTRIAL TECHNICAL EDUCATION STUDENTS IN SOUTH-EAST NIGERIA

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Abstract

The growing increase in the integration of artificial intelligence (AI) into industrial and technical work environments has created an urgent demand for ethically literate graduates capable of navigating AI-related challenges in professional practice. Notwithstanding this growing imperative, AI ethics education remains largely absent from Technical and Vocational Education and Training (TVET) curricula in Nigerian universities. Hence, this has left a critical gap between graduate competencies and evolving industry expectations. This study therefore investigated undergraduate TVET students' awareness and understanding of AI ethics in South-East Nigerian universities, and examined the extent to which existing TVET curricula address these competencies. Guided by three research questions, a descriptive survey research design was adopted, with data collected from 350 undergraduate TVET students selected through stratified random sampling across five federal universities in South-East Nigeria. A validated structured questionnaire was used as the primary data collection instrument. Data were analysed using descriptive statistics and multiple regression analysis. Findings revealed significant deficiencies in students' AI ethics awareness, with an overall mean rating of M = 2.18 and a near-total absence of AI Ethics content within current TVET curricula, with an overall mean rating of M = 1.87. This study contributes empirical evidence to the under-represented intersection of AI ethics and technical teacher education in Sub-Saharan Africa. It therefore concluded that undergraduate TVET students in South-East Nigerian federal universities currently possess inadequate AI ethics competencies across the cognitive dimensions of awareness, and that this inadequacy is structurally attributable to the near-total absence of AI ethics content from existing TVET curriculum frameworks. The study recommended, among other things, that a curriculum infusion strategy through which AI ethics themes are systematically embedded across existing TVET course units, such as Technical Drawing, Workshop Technology, Electrical Installation, and Building Technology, should be adopted.

Keywords: Artificial Intelligence Ethics, Technical and Vocational Education and Training, Curriculum Integration, Nigeria

Introduction

The emergence of artificial intelligence (AI) as a transformative force in industrial and technical sectors has necessitated a fundamental reprogramming of the skills competency demands placed upon technical education graduates worldwide. Artificial intelligence and digital technologies such as machine learning algorithms, natural language processing systems, predictive analytics platforms, and AI-driven automation tools are now integrated across a broad spectrum of industrial domains. These domains include manufacturing, construction, electrical engineering, energy management, and industrial design (UNESCO, 2021; OECD, 2023). This

technological breakthrough is no longer prospective rather observable and increasing rapidly, according to the International Labour Organization. ILO (2019) projected that AI automation will significantly alter task structures across more than 50% of occupational roles in technically oriented industries within the next two decades.

However, in this rapidly evolving landscape, Industrial Technical Education (ITE) as a discipline is the principal carrier of Technical and Vocational Education and Training (TVET), and is saddled with the responsibility of preparing technically proficient and sound educators, engineers, and industrial practitioners. It therefore occupies a position of particular strategic importance. TVET programmes in Nigerian universities are tasked with equipping graduates who will teach, design, operate, and manage in technical and industrial environments, which are rapidly being mediated by AI systems (Olabiyi & Okoye, 2021; Uwaifo, 2010). Yet, the competencies required to function responsibly within AI-integrated industrial environments extend beyond technical proficiency alone. Moreover, several international policy frameworks have consistently affirmed that graduates must also possess AI ethics literacy. This is simply an informed understanding of algorithmic bias, data privacy, fairness, accountability, and the principles of responsible AI deployment (UNESCO, 2021; Floridi et al., 2018; Jobin et al., 2019). Hence, without this ethical dimension, technical competence alone is insufficient to ensure responsible, equitable, and socially beneficial engagement with AI in professional practice.

Furthermore, in the Nigerian context, the adoption of AI technologies across industrial sectors is gaining momentum, driven by government-led digital transformation initiatives and the increasing availability of AI-enabled tools in the manufacturing, construction, and energy sectors (Eze et al., 2022; Onyema et al., 2020). However, this technological momentum is yet to be matched by a corresponding evolution in higher education policy or curriculum design. In addition, Nigerian TVET programmes continue to operate within curriculum frameworks regulated by the National University Commission (NUC) for Universities, National Board for Technical Education (NBTE) for polytechnics and technical colleges and National Commission for Colleges of Education (NCCE) for colleges of education. These frameworks were largely developed before the era of AI diffusion; hence, no systematic provision for AI ethics competency development (Federal Republic of Nigeria, 2013; Olabiyi & Okoye, 2021). This misalignment between curriculum content and the ethical demands of the contemporary industrial environment represents both an educational challenge and a professional risk of considerable significance.

Statement of the Problem

The central problem motivating this study is the documented and consequential misalignment between the AI ethics competencies that TVET graduates in South-East Nigeria are expected to possess. However, this is based on the definition by international AI governance frameworks and the demands of AI-integrated industrial practice, and the competencies that existing TVET curricula in Nigerian universities are currently equipped to develop. AI systems embedded in industrial environments carry well-documented risks of algorithmic bias, discriminatory decision-making, and privacy violation (Benjamin, 2019; Buolamwini & Gebru, 2018; Eubanks, 2018; O'Neil, 2016). Technical professionals who lack the ethical literacy to recognise, interrogate, or mitigate these risks may inadvertently perpetuate or amplify them in their professional practice, with potentially serious consequences for workplace equity, public safety, and institutional accountability.

Nonetheless, despite this professional and ethical imperative, AI ethics education remains conspicuously absent from the curriculum frameworks governing TVET programmes in Nigerian universities. The NUC-regulated curriculum frameworks that structure TVET instruction in Nigerian universities make no explicit provision for AI ethics content training, omissions that reflect a broader policy failure to anticipate the ethical dimensions of AI integration in technical education (Federal Republic of Nigeria, 2013; Olabiyi & Okoye, 2021). In the absence of empirical data on students' current AI ethics competencies, curriculum developers and policymakers are unable to determine the nature or scale of this deficit, nor to design targeted, evidence-informed interventions to address it. The present study was therefore conducted to generate this critical empirical baseline and to derive actionable curriculum development implications from its findings.

Purpose of the Study

The main purpose of this study is to investigate the extent of AI ethics awareness among undergraduate Industrial Technical Education/Technical and Vocational Education and Training students in South-East Nigerian universities. Hence, to derive evidence-based implications for curriculum development in TVET programmes. Specifically, the study sought to:

1. Assess the level of AI ethics awareness among undergraduate TVET students.
2. Determine the extent of AI ethics content integration in existing TVET curricula.
3. Determine the predictive relationship between demographic variables and AI ethics awareness and understanding

Research Questions

The following research questions were raised to guide the study based on the specific purposes:

1. What is the level of AI ethics awareness among undergraduate TVET students?
2. To what extent do existing TVET curricula incorporate AI ethics content?
3. To what extent do demographic variables predict TVET students' AI ethics awareness and understanding?

Significance of the Study

The significance of this study operates simultaneously at empirical, theoretical, methodological, and policy levels. Empirically, it generates the first systematically collected, field-validated dataset on AI ethics awareness among undergraduate TVET students in South-East Nigeria, a population and context for which no comparable baseline data presently exist in the published literature. This empirical contribution addresses a documented and consequential gap, providing curriculum developers, university administrators, and educational policymakers with the evidence-based foundation necessary to design targeted and contextually appropriate curriculum interventions (Creswell & Creswell, 2018; Eze et al., 2022).

Theoretically, the study extends established frameworks in AI ethics education, including Floridi et al.'s (2018) principles and AI ethics framework model, into the under-represented contexts of Industrial Technical Education and Sub-Saharan African higher education. This will contribute to a more geographically and disciplinarily diverse theoretical literature. Methodologically, the development and psychometric validation of a structured survey instrument specifically calibrated to measure AI ethics competencies within a TVET student population constitutes a replicable scholarly contribution that can inform future investigations across analogous institutional contexts in Nigeria and the broader African region (Ndukwe & Daniel, 2020).

From a policy and practice perspective, the study's findings carry direct implications for the National Commission for Colleges of Education, National Board for Technical Education, National University Commission, and TVET programme coordinators, offering a framework for integrating AI ethics literacy into existing curriculum structures without requiring wholesale programme redesign. In a broader sense, by drawing attention to the ethical dimensions of AI adoption in technical education, this study contributes to the global discourse on responsible AI governance in education and to Nigeria's emerging agenda for AI-ready workforce development (Ndukwe & Daniel, 2020; Okonkwo & Ade-Ibijola, 2021; UNESCO, 2021). The findings are therefore of relevance not only to TVET scholars and practitioners in Nigeria but to the wider international community of researchers, policymakers, and educators engaged with the ethical challenges of AI integration in technical and vocational education.

Literature Review

The scholarly literature on AI in education has expanded considerably over the past decade, with researchers documenting the transformative potential of AI for personalised learning, intelligent tutoring, assessment automation, and institutional decision-making (Crompton & Burke, 2023; Holmes et al., 2019; Zawacki-Richter et al., 2019). Parallel to this, a growing body of interdisciplinary scholarship has emerged at the intersection of AI ethics, data governance, and higher education, raising critical questions about algorithmic bias, fairness, transparency, and the governance of AI in institutional contexts (Mittelstadt et al., 2016; Raji et al., 2020; Whittlestone et al., 2019). International bodies including UNESCO (2021), the OECD (2023), and the European Commission (2019) have published comprehensive frameworks calling for AI ethics to be embedded within educational systems at all levels, including technical and vocational education.

Notwithstanding, the majority of empirical research on AI ethics in higher education has been concentrated in North American, European, and East Asian institutional contexts (Jobin et al., 2019; Pedro et al., 2019). Studies such as those by Luckin et al. (2016), Popenici and Kerr (2017), and Miao et al. (2021) have made significant contributions to understanding AI's educational applications, but these works address predominantly Western university populations and general undergraduate disciplines, limiting their direct applicability to the specific structural, resource, and pedagogical realities of Nigerian higher education. More critically, within the sub-field of technical and vocational education and training (TVET), research on AI ethics competencies remains sparse, with only a handful of studies examining how technical education programmes engage or fail to engage with questions of algorithmic accountability, bias literacy, or responsible AI use (King & Boyatt, 2015; Selwyn, 2019; Taddeo & Floridi, 2018).

Within Nigeria specifically, the existing literature on AI and education has largely addressed broad technological adoption patterns, e-learning infrastructure, and digital literacy challenges, with studies by Adedokun-Shittu & Shittu (2015), Aderibigbe and Matarirano (2021), and Onyema et al. (2020) contributing valuable descriptive insights into technology integration challenges in the Nigerian university sector. However, none of these studies has directly investigated AI ethics awareness among students in any technical education programme in Nigeria. The domain of Industrial Technical Education has received particularly limited scholarly attention in relation to AI ethics, representing a significant lacuna in the evidence base available to curriculum developers, policymakers, and educational administrators.

A critical review of the existing literature reveals three intersecting and mutually reinforcing gaps that the present study is designed to address. First, there is a pronounced geographical gap: the empirical literature on AI ethics in higher education is heavily skewed toward developed country contexts, with Sub-Saharan Africa and Nigeria in particular significantly under-represented in the published scholarly record (Aggarwal, 2020; Ndukwe & Daniel, 2020; Okonkwo & Ade-Ibijola, 2021). The contextual specificities of AI ethics challenges in the Nigerian higher education environment, including regulatory underdevelopment, infrastructure constraints, and culturally embedded technology trust dynamics, demand regionally situated, empirically grounded investigation that currently does not exist.

On the other hand, there is a clear disciplinary gap: while AI ethics scholarship in education has begun to engage with computer science, information technology, and general undergraduate populations, its intersection with Industrial Technical Education as a distinct professional discipline has not been systematically examined (Crompton & Burke, 2023; Olabiyi & Okoye, 2021). TVET presents a unique disciplinary context because its graduates will not merely use AI as learners, but will deploy, maintain, and teach with AI systems in consequential industrial settings. This is a professional problem that carries specific ethical responsibilities and risks not addressed in existing AI ethics education research.

Furthermore, and more acutely, there is an empirical gap: no documented study has systematically measured the level of AI ethics awareness among undergraduate TVET students in South-East Nigerian universities. The absence of this foundational empirical baseline means that any attempt to design, advocate for, or evaluate AI ethics integration in TVET curricula currently proceeds without the evidence-based grounding that rigorous curriculum reform requires (Eze et al., 2022; Nnaji et al., 2021). It is precisely this tripartite gap geographical, disciplinary, and empirical that the present study addresses.

Method

This study adopted a quantitative research approach as the primary mode of inquiry by employing a descriptive survey research design. The study was conducted within the five federal universities in South-East Nigeria that offer accredited undergraduate programmes in TVET-related disciplines. The target population for this study comprised all undergraduate students enrolled in Industrial Technical Education programmes across the five federal universities in South-East Nigeria in the 2024/2025 academic session. Based on available enrolment data obtained from the academic registries of the participating institutions, the estimated total population was approximately 2,500 undergraduate TVET students across all levels (100 - 400 levels), including both male and female students from diverse socioeconomic and geographic backgrounds within the South-East zone.

A stratified random sampling technique was used to select participants for this study. The 350 participants were allocated proportionally across the five institutions based on each institution's share of the total TVET student population, and further stratified by academic level (100, 200, 300, and 400 levels) within each institution.

Data were collected using a structured questionnaire developed by the researcher. The questionnaire was titled the "*AI Ethics Awareness and Curriculum Reform Scale" (AEACRS)*. The AEACRS was subjected to a rigorous multi-stage validation process before the main data collection exercise. Content validity was established by submitting the initial instrument to a panel of six subject-matter experts, comprising two lecturers in Industrial Technical Education,

two specialists in educational measurement and evaluation, and two researchers with expertise in AI ethics and digital literacy education. The panellists were asked to evaluate each item for clarity, relevance, and representativeness using a Content Validity Index (CVI) rating procedure (Polit & Beck, 2006). Items with an item-level CVI (I-CVI) score below 0.80 were revised or removed, and the scale-level CVI (S-CVI) of the final instrument was confirmed at 0.86, exceeding the minimum threshold of 0.80 recommended for acceptable content validity (Lynn, 1986).

Construct validity was established after a pilot study was conducted with 40 undergraduate TVET students drawn from a federal university outside the South-East zone who were not included in the main study sample. Internal consistency (reliability) of the instrument was assessed using Cronbach's alpha formula, computed from the pilot study data. The alpha coefficients obtained were: AI Ethics Awareness Scale ($\alpha = 0.84$) and Curriculum Content Perception Scale ($\alpha = 0.79$). The two subscales exceeded the minimum acceptable threshold of $\alpha \geq 0.70$ recommended for research instruments in social science and education research (Field, 2018; Nunnally & Bernstein, 1994), confirming adequate internal consistency. The overall instrument reliability was $\alpha = .82$, indicating a high level of scale coherence.

Data were collected by paper-based administration of questionnaires during scheduled contact sessions, with the consent of the relevant lecturers. A total of 370 questionnaires were distributed across the five institutions, and 358 were returned, representing a return rate of 96.8%. Upon screening for completeness and response quality, 8 questionnaires were excluded because they were badly filled. The final usable sample comprised 350 questionnaires, yielding an effective response rate of 94.6%, which is considered excellent for survey research in educational settings (Fraenkel et al., 2019).

Data obtained from the AEACRS were analysed using the Statistical Package for the Social Sciences (SPSS), Version 27.0. Two principal analytical techniques were employed, corresponding to the study's descriptive and inferential objectives. Descriptive statistics such as frequencies, percentages, means, and standard deviations were computed for all demographic variables and for the two subscale scores. Mean scores on each subscale were interpreted using a criterion-referenced mean score decision rule: scores of 1.00 – 2.49 were interpreted as Low, scores of 2.50 – 3.49 as Moderate, and scores of 3.50 – 5.00 as High, consistent with the interpretive conventions employed in comparable descriptive survey research in Nigerian education studies (Cohen et al., 2018; Eze et al., 2022). Descriptive analysis was used to address research questions one and two. Multiple regression analysis was performed to address research question three, examining the extent to which students' demographic and academic characteristics (gender, academic level, institution, access to digital devices, and prior AI coursework exposure) predicted their scores on the AI Ethics Awareness.

Results

This section presents the findings of the study in accordance with the research questions and corresponding specific objectives outlined above.

Demographic Characteristics of Respondents

Table 1 presents the demographic profile of the 350 respondents across the five participating federal universities in South-East Nigeria.

Table 1

Demographic Characteristics of Respondents (N = 350)

Variable	n	% of Total Sample
Gender		
Male	218	62.3
Female	132	37.7
Academic Level		
100 Level	85	24.3
200 Level	107	30.6
300 Level	98	28.0
400 Level	60	17.1
Digital Device Access		
Regular access	231	66.0
Limited/no access	119	34.0
Prior AI Coursework Exposure		
Yes	52	14.9
No	298	85.1

Research question 1: What is the level of AI ethics awareness among undergraduate TVET students?

Table 2 presents the descriptive statistics for the AI Ethics Awareness subscale of the AEACRS.

Table 2: Descriptive Statistics for AI Ethics Awareness Subscale (N = 350)

S/N	Item	M	SD	Interpretation
1	I am aware of the meaning of artificial intelligence (AI) ethics	2.31	0.78	Low
2	I understand the principle of transparency in AI systems	2.01	0.72	Low
3	I can explain what algorithmic accountability means	2.09	0.74	Low
4	I am aware of data privacy rights in AI applications	1.94	0.68	Low
5	I know that AI systems can produce unfair or biased outcomes	2.53	0.83	Moderate
6	I understand the concept of fairness in AI design	2.51	0.82	Moderate
7	I am aware of ethical guidelines governing AI use in industry	2.03	0.69	Low
8	I understand the meaning of informed consent in AI data collection	2.12	0.71	Low
9	I am aware of the societal risks posed by unethical AI deployment	2.26	0.76	Low
10	I know of any national or international framework for AI ethics	1.97	0.65	Low
11	I can identify an example of AI ethics violation in an industrial context	2.08	0.70	Low
12	I understand what is meant by explainability in AI systems	2.14	0.73	Low

13	I am aware that my ITE training has covered AI ethics concepts	1.89	0.63	Low
14	I understand the concept of responsible data stewardship in AI	2.05	0.69	Low
15	I have been exposed to literature or training on AI ethics	2.47	0.80	Low
	Overall Subscale Mean	**2.18**	**0.71**	**Low**

Note. M = Mean; SD = Standard Deviation. Decision rule: 1.00–2.49 = Low; 2.50–3.49 = Moderate; 3.50–5.00 = High. Scale: 1 = Strongly Disagree to 5 = Strongly Agree.

Research question 2: To what extent do existing TVET curricula incorporate AI ethics content?

Table 3 presents the descriptive statistics for the Curriculum Content Perception subscale.

Table 3: Descriptive Statistics for Curriculum Content Perception Subscale (N = 350)

S/N	Item	M	SD	Interpretation
1	My TVET curriculum includes content on AI ethics principles	1.82	0.59	Low
2	I have received formal instruction on algorithmic bias in my courses	1.73	0.57	Low
3	Responsible AI use is addressed in my TVET programme	1.81	0.59	Low
4	My lecturers have discussed AI-related ethical challenges in class	1.94	0.63	Low
5	My curriculum includes content on data privacy in AI applications	1.84	0.60	Low
6	AI ethics frameworks or guidelines have been covered in my courses	1.79	0.59	Low
7	Responsible data handling in AI contexts is part of my training	1.76	0.58	Low
8	My programme prepares me to handle AI ethics issues at work	1.91	0.62	Low
9	Ethics in emerging technology has been discussed in at least one course	2.21	0.71	Low
10	I feel my TVET training equips me to engage responsibly with AI	1.96	0.63	Low
	Overall Subscale Mean	**1.87**	**0.61**	**Low**

Note. M = Mean; SD = Standard Deviation. Decision rule: 1.00–2.49 = Low; 2.50–3.49 = Moderate; 3.50–5.00 = High.

Summary of Subscale Means across the two AI Ethics Competency Dimensions

Table 4 provides a consolidated summary of the overall mean scores, standard deviations, and interpretations across the two AEACPS subscales.

Table 4: Summary of Overall Subscale Means and Interpretations (N = 350)

S/N	Sub-scale	M	SD	Interpretation	RQ
1	AI Ethics Awareness	2.18	0.71	Low	RQ1
2	Curriculum Content Perception	1.87	0.61	Low	RQ2

Note. M = Mean; SD = Standard Deviation; RQ = Research Question. Decision rule: 1.00–2.49 = Low; 2.50–3.49 = Moderate; 3.50–5.00 = High.

The data reveal a consistent pattern of low AI ethics competency across the study population. The two subscales AI Ethics Awareness (M = 2.18), and Curriculum Content Perception (M = 1.87) recorded overall means in the Low interpretive range. Across the two subscales, the Curriculum Content Perception dimension recorded lower overall mean (M = 1.87, SD = 0.61), indicating the most acute deficit of all measured dimensions.

Research Question 3: To what extent do demographic variables predict TVET students' AI ethics awareness and understanding?

To address this research question of the study, a standard multiple regression analyses was conducted to examine the extent to which selected demographic variables: gender, academic level, digital device access, and prior AI coursework exposure collectively and individually predicted scores on the outcome measures: AI Ethics Awareness (AEA). The demographic predictors were entered simultaneously in a single block, consistent with the exploratory and cross-sectional nature of the study design (Field, 2018; Tabachnick & Fidell, 2019). Prior to conducting the regression analyses, the data were examined for conformity to the standard assumptions of multiple regressions.

Assumption Testing

Multi-collinearity among the predictor variables was conducted using Variance Inflation Factors (VIF) and Tolerance statistics. Table 5 shows all VIF values were below the conventional threshold of 10.0, and all Tolerance values exceeded 0.10, indicating no evidence of harmful multi-collinearity among the predictors (Hair et al., 2019).

Table 5: Multi-collinearity Diagnostics: Variance Inflation Factors (VIF) and Tolerance Statistics

Predictor	Tolerance	VIF	Decision
Gender	0.993	1.007	No multi-collinearity
Academic Level	0.970	1.031	No multi-collinearity
Digital Device Access	0.995	1.005	No multi-collinearity
Prior AI Coursework	0.973	1.028	No multi-collinearity

Note. VIF = Variance Inflation Factor. Tolerance = 1/VIF. VIF < 10 and Tolerance > 0.10 indicate absence of problematic multi-collinearity (Hair et al., 2019).

Normality of residuals was evaluated using skewness and kurtosis indices and the Shapiro-Wilk test on a random sub-sample of residuals (n = 50). For the AI Ethics Awareness model, residual skewness was −0.03 and kurtosis was −0.43. The residual distributions fall within the acceptable range of ±1.0 for skewness and ±3.0 for kurtosis recommended for regression analyses (George & Mallery, 2019). Shapiro-Wilk results was not-significant for the models (AEA: W = 0.961, p = .100), supporting the normality assumption. All four conditions for

standard multiple regression (linearity, independence, homoscedasticity, and normality of residuals) were therefore judged to be satisfactorily met.

Regression Model: Predictors of AI Ethics Awareness

The model fit statistics for the regression analysis, in which the four demographic variables were regressed on AI Ethics Awareness scores as presented in Table 6 below.

Table 6: Model Summary: Multiple Regression on AI Ethics Awareness (N = 350)

Model	R	R^2	Adjusted R^2	F	P
Demographics → AEA	0.363	0.132	0.122	13.131 (4, 345)	< 0.001

*Note. AEA = AI Ethics Awareness. R = Multiple Correlation Coefficient; R^2 = Coefficient of Determination; Adjusted R^2 = Bias-corrected R^2. F-test df = (4, 345). ***p <0.001.*

The overall regression model for AI Ethics Awareness was statistically significant, $F(4, 345) = 13.131$, $p < 0.001$. The model accounted for 13.2% of the variance in AI Ethics Awareness scores ($R^2 = .132$), with an adjusted R^2 of 0.122, indicating that approximately 12.2% of the variance in awareness was explained by the four demographic predictors after correcting for model complexity. The multiple correlation coefficient was R = 0.363, reflecting a small-to-moderate overall association between the predictor set and the outcome variable.

Table 7: *Regression Coefficients: Demographic Predictors of AI Ethics Awareness (N = 350)*

Predictor	B	SE	β	t	p	r	95% CI	Sig.
(Constant)	1.654	0.094	—	17.541	< .001	—	—	***
Gender	0.194	0.061	.161	3.197	.0015	.168	[0.075, 0.313]	**
Academic Level	0.096	0.029	.169	3.327	.0010	.131	[0.039, 0.153]	***
Digital Device Access	0.202	0.062	.164	3.265	.0012	.173	[0.080, 0.324]	**
Prior AI Coursework	0.408	0.084	.248	4.883	< .001	.219	[0.244, 0.572]	***

*Note. B = Unstandardised regression coefficient; SE = Standard Error; β = Standardised regression coefficient; r = Zero-order Pearson correlation; 95% CI = 95% Confidence Interval for B. *p <0.05. **p < 0.01. ***p < 0.001.*

Table 7 above presents the individual predictor coefficients for AI Ethics Awareness Model. It can be observed from the table that all the four demographic variables made statistically significant independent contributions to the prediction of AI Ethics Awareness. Prior AI Coursework Exposure emerged as the strongest predictor (β = 0.248, $t = 4.883$, $p < 0.001$; 95% CI [0.244, 0.572]), indicating that students who had previously been exposed to AI-related coursework scored significantly higher on AI ethics awareness than those who had not, controlling for all other predictors. The zero-order correlation (r = 0.219) confirmed a meaningful bi-variate relationship between prior AI coursework and awareness. Digital Device Access was the second strongest predictor (β = 0.164, $t = 3.265$, $p = 0.001$; 95% CI [0.080, 0.324]), with students having regular access to digital devices exhibiting higher awareness than those with limited or no access. Academic Level also contributed significantly (β = 0.169, $t = 3.327$, $p = 0.001$; 95% CI [0.039, 0.153]), suggesting that AI ethics awareness increased incrementally

across successive academic levels. Gender was a statistically significant predictor (β = 0.161, *t* = 3.197, *p* = 0.002; 95% CI [0.075, 0.313]), with male students recording higher mean awareness scores than female students, though the effect size was small.

Discussion of Findings

This section presents the interpretation and discussion of the findings of the study in relation to the research questions, the existing body of literature, and the broader theoretical context of AI ethics education in TVET. The discussion addresses both the descriptive findings presented above and the inferential findings generated through the multiple regression analysis.

Low AI Ethics Awareness among TVET Students

The first research question sought to determine the level of AI ethics awareness among undergraduate TVET students in South-East Nigerian federal universities. The descriptive findings revealed an overall subscale mean of *M* = 2.18 (SD = 0.71), which falls within the Low interpretive range. Item-level analysis further confirmed that students demonstrated consistently low awareness across the majority of AI ethics constructs measured, including data privacy rights (*M* = 1.94), algorithmic accountability (*M* = 2.09), and knowledge of national or international AI ethics frameworks (*M* = 1.97). Only two items awareness that AI systems can produce biased outcomes (*M* = 2.53) and understanding of fairness in AI design (*M* = 2.51) reached the Moderate interpretive threshold, suggesting that rudimentary general familiarity with AI fairness exists even in the absence of formal instruction.

These findings are consistent with the broader pattern documented in the international literature indicating that AI ethics awareness among undergraduate students outside of computer science and information systems disciplines remains markedly low, particularly in sub-Saharan African institutional contexts (Aggarwal, 2020; Ndukwe & Daniel, 2020; Nnaji et al., 2021). The results extend and empirically substantiate the theoretical argument advanced by Floridi et al. (2018) and Jobin et al. (2019) that AI ethics literacy cannot be assumed to develop organically through general technology use but must be explicitly cultivated through targeted educational intervention. Crucially, the present findings situate this argument within the under-represented context of Industrial Technical Education in Nigeria, a professional discipline whose graduates will deploy, maintain, and teach with AI systems in consequential industrial settings a responsibility that demands a level of ethical preparedness not currently reflected in their measured awareness.

Near-Total Absence of AI Ethics Content in TVET Curricula

The second research question examined the extent to which existing TVET curricula in South-East Nigerian federal universities incorporate AI ethics content. The Curriculum Content Perception subscale recorded the lowest overall mean of the two subscales (*M* = 1.87, SD = 0.61), with all ten items falling within the Low range and no item exceeding a mean of 2.21. Particularly striking were the mean scores for formal instruction on algorithmic bias (*M* = 1.73) and responsible data handling in AI contexts (*M* = 1.76), which were the lowest recorded across both subscales. These findings confirm the study's central hypothesis: that AI ethics content is virtually absent from the curriculum frameworks governing undergraduate TVET programmes in the South-East Nigerian university sector.

This finding is both empirically significant and practically alarming. It provides the first field validated quantitative evidence for a curriculum gap that had previously been identified only inferentially through policy analysis (Federal Republic of Nigeria, 2013; Olabiyi & Okoye, 2021).

The result is consistent with the position advanced by UNESCO (2021) and the OECD (2023) that curriculum frameworks in technical education globally have not kept pace with the ethical demands of AI integrated industrial environments a problem that is particularly acute in regulatory environments, such as Nigeria's, where the NUC, NBTE, and NCCE Minimum Academic Standards were developed prior to the current era of AI diffusion. The present findings therefore add important empirical weight to calls for systematic regulatory reform of TVET curriculum standards, and provide the evidence base that such reform requires.

Demographic Predictors of AI Ethics Awareness

The multiple regression analysis for AI Ethics Awareness Model demonstrated that the four demographic variables collectively accounted for 13.2% of the variance in AI Ethics Awareness scores (Adjusted $R^2 = 0.122$), with the overall model reaching statistical significance, $F(4, 345) = 13.131$, $p < 0.001$. While the proportion of explained variance is modest as would be expected in a cross-sectional descriptive study using broad demographic proxies rather than fine grained attitudinal or motivational measures, it is statistically meaningful and carries substantive interpretation.

Prior AI Coursework Exposure was the strongest individual predictor of AI Ethics Awareness ($\beta = 0.248$, $p < 0.001$), contributing a unique and statistically significant increment of variance after controlling for all other predictors. This finding is theoretically coherent and practically significant. It confirms that formal, structured exposure to AI related content even when not explicitly framed as AI ethics instruction creates cognitive scaffolding that facilitates greater ethical awareness. This is consistent with Miao et al. (2021) and Pedro et al. (2019), who argued that AI literacy, including its ethical dimension, develops most robustly within formal educational encounters rather than through informal technology use alone. The implication for curriculum design is direct. The deliberate integration of AI ethics content into TVET courses, as a compulsory and formally assessed component, is likely to yield measurable improvements in student awareness.

Digital Device Access emerged as the second strongest predictor ($\beta = 0.164$, $p = 0.001$), suggesting that students with regular access to digital tools and platforms are better positioned to encounter, engage with, and develop awareness of AI related ethical issues. This finding reflects a broader digital inequality dynamic well documented in the Nigerian higher education context (Adedokun-Shittu & Shittu, 2015; Onyema et al., 2020). Consequently, differential access to digital infrastructure mediates not only technological skill acquisition but also exposure to AI related discourse. It carries an equity related implication for curriculum design. However, if digital access continues to be unequally distributed across the TVET student population, AI ethics curriculum interventions delivered exclusively through digital platforms risk amplifying existing inequalities in AI literacy.

Academic Level was a significant predictor in the model, with AI Ethics Awareness ($\beta = 0.169$, $p = 0.001$). This pattern is consistent with the general developmental trajectory of academic literacy and critical thinking across undergraduate programmes and is also likely to reflect cumulative exposure to technology related content across increasing academic years. Importantly, however, even 400 level students recorded overall AI ethics awareness in the Low to Moderate range, confirming that academic progression alone, without targeted curriculum content, does not produce adequate AI ethics competency.

Gender was a statistically significant predictor of AI Ethics Awareness (β = 0.161, p = 0.002), with male students recording modestly higher scores. This differential pattern suggests that the observed gender gap in awareness may reflect differences in informal AI engagement and media exposure. This finding is consistent with the gender digital divide literature in sub-Saharan African higher education contexts (Aderibigbe & Matarirano, 2021) and points to the importance of designing gender inclusive AI ethics curricula that do not presuppose prior informal familiarity with AI systems.

Conclusion

From the data obtained as the findings of this study, it can be concluded that undergraduate TVET students in South-East Nigerian federal universities currently possess inadequate AI ethics competencies across the cognitive dimensions of awareness, and that this inadequacy is structurally attributable to the near total absence of AI ethics contents from existing TVET curriculum frameworks. The findings confirm the existence of a consequential and evidence documented misalignment between the ethical demands of AI-integrated industrial workplaces and the competencies produced by current TVET curricula in South-East Nigeria. This misalignment demands urgent, systematic, and evidence based curricular reform. These conclusions are consistent with and extend the positions advanced in the literature by Floridi et al. (2018), Jobin et al. (2019), Mittelstadt et al. (2016), and Olabiyi and Okoye (2021), and provide the first empirically grounded evidence base for this determination within the South-East Nigerian TVET context.

Recommendations

1. Curriculum developers are recommended to design and integrate a stand-alone, credit bearing module in AI Ethics, into the undergraduate TVET programme structure.
2. Curriculum developers should adopt a curriculum infusion strategy through which AI ethics themes are systematically embedded across existing TVET course units: such as Technical Drawing, Workshop Technology, Electrical Installation, and Building Technology.
3. All the Academic Supervisory boards such as: NUC, NBTE and NCCE are recommended to revise the Minimum Academic Standards (MAS) for TVET programmes across Nigerian tertiary institutions to include explicit requirements for AI ethics, as mandatory core components of all accredited TVET programme curricula.
4. TVET lecturers in South-East Nigerian federal universities are recommended to participate in a structured professional development programmes in AI ethics education.

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