

STAKEHOLDERS' AWARENESS, PERCEPTIONS, UTILIZATION AND OBSERVED CHALLENGES OF ARTIFICIAL INTELLIGENCE INTEGRATION IN BUILDING CONSTRUCTION EDUCATION IN TECHNICAL COLLEGES IN EDO STATE

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Abstract

This study investigated stakeholders' awareness, perceptions, utilization, and observed challenges of Artificial Intelligence (AI) integration in Building Construction Education in Technical Colleges in Edo State, Nigeria using a descriptive survey research design. Guided by the Unified Theory of Acceptance and Use of Technology (UTAUT), the population comprised 344 stakeholders, including students, teachers, administrators, parents, and employers involved in building construction education in government-owned Technical Colleges in Edo State. Given the manageable size of the population, a census approach was employed for students, teachers, and administrators, while convenience sampling was used to reach parents and employers who were available and willing to participate during data collection. A total of 333 valid responses were retrieved and analyzed. Data were collected using a structured questionnaire titled Stakeholders' AI Integration in Building Construction Education Questionnaire (SAIBCEQ), with a Cronbach's Alpha reliability coefficient of .82. Mean and standard deviation were used to answer the research questions, while one-way Analysis of Variance (ANOVA) was used to test the hypotheses at the .05 level of significance. Where significant differences existed, Tukey HSD post hoc test was conducted to identify specific stakeholder groups responsible for the observed differences. Findings revealed moderate awareness ($M = 2.59$), favourable perceptions ($M = 3.46$), very low utilization ($M = 1.49$), and high perceived challenges ($M = 3.60$) of AI integration among stakeholders. Significant differences existed among stakeholder groups in awareness, perceptions, and utilization, while no significant difference was found in observed challenges. The study recommended improved digital infrastructure, teacher training, and curriculum integration to enhance AI adoption in Technical Colleges in Edo State.

Keywords: Artificial Intelligence, Building Construction Education, Stakeholders' Awareness, Perceptions, Utilization, Observed Challenges, Technical Colleges

Introduction

The core objective of Technical and Vocational Education and Training (TVET) in Nigeria, like elsewhere across the globe, is to equip students with both academic knowledge and practical skills required in today's technologically dynamic society. This is to ensure that learners graduate as job-ready and self-sustainable individuals, capable of engaging in small-scale enterprises and possessing competencies that align with industry demands. This mandate is aligned with national development priorities and the Sustainable Development Goals (SDGs), particularly Goal 1, 4, and 8, which address 'no poverty', 'quality education', and 'decent work and economic growth' respectively.

Building construction education is one of the most vital trade disciplines offered in Nigerian Technical Colleges, aimed at developing skilled personnel for the built environment. The discipline combines theoretical instruction with hands-on training in areas such as building materials and their properties, basic construction technology, workshop practice, building finishes and maintenance, site tools and equipment, safety practices, and basic construction management. However, the construction industry itself is undergoing rapid technological transformation, with Artificial Intelligence (AI), a branch of computer science focused on building machines that can perform

tasks typically requiring human intelligence. Instead of just following rigid, step-by-step instructions, AI systems learn, reason, and make decisions. Building Information Modelling (BIM), digital simulation platforms, and AI-supported project management systems increasingly shaping professional practice (Akinosho et al., 2020; Olanrewaju et al., 2020). This shift implies that construction technicians are now expected to possess not only manual competencies but also digital skills aligned with contemporary industry standards (Oke et al., 2020; Aghimien et al., 2022).

This study is conceptually anchored on the Unified Theory of Acceptance and Use of Technology (UTAUT), proposed by Viswanath Venkatesh and colleagues. The model explains technology adoption as a function of key determinants, including performance expectancy, effort expectancy, social influence, and facilitating conditions, alongside moderating factors such as user characteristics and contextual variables. Within the context of this study, stakeholders' awareness of artificial intelligence may be understood as a precursor to expectancy beliefs, while utilization reflects actual use behaviour. Similarly, perceived institutional constraints, availability of infrastructure, and exposure to digital tools align with facilitating conditions that shape adoption outcomes. Differences among students, teachers, administrators, parents, and employers may also reflect variations in social influence and contextual readiness. Although UTAUT was originally developed in organizational and information systems contexts, its application in educational technology research has been widely acknowledged, particularly in explaining uneven patterns of technology adoption across institutional settings. Anchoring this study within the UTAUT framework therefore provides a structured basis for interpreting how stakeholder characteristics and environmental factors interact to influence the integration of artificial intelligence in building construction education.

The rapid advancement of artificial intelligence continues to reshape industrial practices and educational expectations across multiple sectors, particularly within engineering and construction. In recent years, AI-enabled systems have increasingly been applied in areas such as design optimization, predictive maintenance, construction scheduling, and risk assessment, signaling a shift toward data-driven decision-making in construction processes (Oesterreich & Teuteberg, 2021; Pan & Zhang, 2021). This transformation is closely linked to broader digitization trends associated with Industry 4.0, where automation, big data, and intelligent systems are redefining productivity and efficiency across the built environment (Bilal et al., 2021). Although these developments are more pronounced in advanced economies, their influence is gradually extending to developing contexts, though often constrained by infrastructural and institutional limitations (Whyte, 2019; Wang & Chen, 2023). Nevertheless, despite its considerable transformative potential, increasing attention is being drawn to the possible adverse implications of AI adoption, particularly in relation to ethical concerns, data privacy, skill displacement, and over-reliance on automated decision systems if not adequately regulated (Dwivedi et al., 2023; UNESCO, 2023).

However, within education sector in Nigeria, particularly TVET, the integration of emerging technologies such as artificial intelligence remains highly uneven. Global studies suggest that while digital transformation is increasingly central to education policy, vocational institutions frequently lag behind due to limited infrastructure, inadequate teacher preparedness, and rigid curricula that are slow to respond to technological change (Zawacki-Richter et al., 2020; UNESCO, 2021; OECD, 2021). These challenges are not merely technical but also structural, reflecting deeper issues of funding, governance, and institutional capacity (Baker & Smith, 2019). In many contexts, including developing countries, this results in a situation where awareness of AI exists, but meaningful classroom integration remains limited (Ifenthaler & Yau, 2020).

In Nigeria, the integration of AI and digital technologies within TVET reflects broader systemic challenges. Studies have identified persistent issues such as inadequate funding, insufficient ICT infrastructure, and limited professional development opportunities for educators, all of which restrict effective technology integration (Olanrewaju et al., 2020; Aghimien et al., 2022). Within technical colleges offering building construction, these constraints are further intensified by the practical nature of the discipline, which relies heavily on workshop-based instruction and manual

skill development. As a result, digital tools, including AI-supported applications, are often absent from formal teaching and learning processes.

Students in technical colleges represent a critical group in this transition. At graduation in building construction programme, they are expected to have acquired competencies that reflect both traditional construction practices and emerging technological trends. However, evidence suggests that their exposure to AI-related tools is often limited or informal, largely dependent on individual capacity rather than institutional structured curriculum design (Luckin et al., 2016; Holmes et al., 2019). While many students may access digital technologies independently, particularly through mobile devices, the absence of guided instructional use limits the educational value of such exposure.

Teachers also play a central role in determining the extent to which artificial intelligence can be integrated into instructional practice. Their pedagogical competence, technological literacy, and willingness to adopt new tools significantly influence learning outcomes. However, research indicates that many educators in vocational settings face challenges in adapting to digital technologies due to insufficient training and lack of institutional support (Zawacki-Richter et al., 2020; Bower, 2021). This often results in continued reliance on traditional teaching methods, even where digital alternatives may offer improved instructional effectiveness.

Administrators, including principals and vice principals, influence institutional readiness through policy implementation, resource allocation, and strategic planning. Yet, their capacity to drive technological transformation is often constrained by financial limitations and competing institutional priorities. Even where there is awareness of the importance of digitalization, implementation tends to remain gradual and fragmented due to systemic constraints (Baker & Smith, 2019; OECD, 2021).

Parents constitute another key stakeholder group whose perceptions and expectations shape the acceptance of technological innovations in education. Parental attitudes toward AI integration can influence students' motivation, access to digital resources at home, and overall support for technology-enhanced learning. In many developing contexts, however, parents' awareness of AI remains limited, and concerns about costs, relevance, and job displacement often affect their willingness to encourage digital skill acquisition among their children (Ifenthaler & Yau, 2020; UNESCO, 2021).

From the industry perspective, employers in the construction sector are increasingly adopting digital tools to enhance efficiency, accuracy, and project management outcomes. Although full-scale artificial intelligence adoption is still emerging in many local contexts, there is growing emphasis on digital competence, adaptability, and familiarity with technology-supported construction processes (Oesterreich & Teuteberg, 2021; McKinsey Global Institute, 2021). This evolving expectation creates pressure on educational institutions to align training outcomes with industry requirements, particularly in preparing graduates for digitally mediated work environments (World Economic Forum, 2020). The mismatch between industry expectations and the skills produced by technical colleges underscores the need to examine how AI is currently perceived and utilized within building construction education.

AI tools in building construction education is programmed to leverage natural language processing, machine learning, and generative models to support both instructors and students. For example, generative AI (e.g., Ernie Bot and ChatGPT) is used to provide personalized learning experiences by analyzing students' performance data and tailoring educational content to meet individual needs (Yoon et al., 2024). In building technology specifically, empirical studies show that AI integration enhances skills acquisition and employability. A study on building technology undergraduates in Oyo State found that AI tools positively influence both soft and technical skills development, helping students to set up and manage construction-related ventures (Ayoola, 2025). Similarly, Ogbebor (2025) reported significant positive correlations between AI tool usage and TVET students' learning abilities, problem-solving, and critical thinking skills in South-South Nigeria, including Edo State. Within construction education, AI-powered Building Information Modelling (BIM) and intelligent tutoring systems provide step-by-step visualization, virtual project

work, and personalized feedback (Tola, 2022; Wang et al., 2023; Abdulmumin & Adebisi, 2023). In a typical classroom and building construction workshop, teachers can use any suitable available number of AI tools to assign construction tasks based on each student's learning pace and proficiency level. This personalized guidance enhances students' understanding of complex concepts and allows teachers to focus on providing more targeted support (Yi et al., 2024). This approach could enhance instructors in technical colleges Edo State to focus on targeted mentorship while students engage with adaptive simulations that mirror actual site challenges, bridging the gap between theory and practice. Such applications align with NBTE's push to decentralize AI and machine learning tools for polytechnics and technical colleges, using offline, Linux-based platforms to overcome connectivity barriers (Vanguard News, 2025). International reviews also highlight that generative AI applications in architecture, engineering, and construction are reshaping practice and education, with implications for upskilling and curriculum redesign (Onatayo et al., 2024).

Statement of the Problem

Overall, the literature points to a widening gap between technological advancement in the construction industry and its integration within vocational education systems. While industry practices are increasingly shaped by artificial intelligence and digital tools, Technical Colleges in Nigeria, particularly Edo State, appear to be transitioning at a slower pace, resulting in potential mismatches between graduate competencies and workplace expectations. Despite growing global interest in artificial intelligence in education, empirical studies focusing specifically on building construction education within technical colleges in developing contexts remain limited. Much of the existing research has focused on higher education or general digital learning environments, leaving vocational and trade-specific disciplines underexplored (Holmes et al., 2019; Zawacki-Richter et al., 2020). It is against this background that the present study examines stakeholder perspectives on the integration of artificial intelligence in building construction education in Technical Colleges in Edo State, Nigeria.

Research Questions

The study was guided by the following research questions:

1. What are the levels of awareness, perceptions, utilization, and observed challenges of Artificial Intelligence integration among stakeholders in building construction education in Technical Colleges in Edo State?
2. What differences exist in stakeholders' awareness of AI integration in building construction education in Technical Colleges in Edo State?
3. What differences exist in stakeholders' perceptions of AI integration in building construction in Technical Colleges in Edo State?
4. What differences exist in the level of utilization of AI among stakeholders' in building construction in Technical Colleges in Edo State?
5. What differences exist in stakeholders' observed challenges of AI integration in building construction in Technical Colleges in Edo State, Nigeria?

Methods

The study adopted a descriptive survey research design. This design was used to collect quantitative data on stakeholders' awareness, perceptions, utilization, and observed challenges of Artificial Intelligence integration in building construction education in Technical Colleges in Edo State, without manipulating any variable. It also allowed for comparison of responses across the five stakeholder groups.

The population of the study comprised all stakeholders involved in building construction education in the five Edo State government-owned Technical Colleges. The total accessible

population was 344, consisting of 160 final-year students, eight teachers, 10 administrators, 80 employers, and 86 parents. Given the relatively manageable size of the population, a census approach was adopted for students, teachers, and administrators, whereby all individuals in these categories were included in the study. However, convenience sampling was employed to select parents and employers who were readily available and willing to participate during the period of data collection.

Data were collected using a structured questionnaire titled “Stakeholders’ AI Integration in Building Construction Education Questionnaire (SAIBCEQ)”. The questionnaire was divided into five sections: demographic information, awareness of Artificial Intelligence, perceptions of AI integration, utilization of AI tools, and observed challenges. Items were rated on a 4-point scale ranging from Strongly Agree (4) to Strongly Disagree (1).

The instrument was subjected to face and content validation by two experts in building construction education in Technical and Vocational Education and Training (TVET) and one expert in Measurement and Evaluation from a Nigerian university. Their suggestions were incorporated to improve clarity, relevance, and appropriateness of the items.

To establish reliability, the questionnaire was pilot-tested on 20 respondents with similar characteristics outside the study area. The data obtained were analyzed using Cronbach’s Alpha, which yielded a reliability coefficient of .82. This indicated that the instrument was internally consistent and suitable for the study.

The questionnaire was administered directly by the researcher with the assistance of two trained research assistants who were familiar with the technical college environment in Edo State. Prior to administration, approval was obtained from the principals of the selected Technical Colleges and from the management of the participating construction firms.

For students and teachers, the questionnaires were distributed and collected during regular school hours in classroom settings to ensure focused responses. For administrators and employers, the questionnaires were administered at their offices and project sites respectively at agreed times to avoid disruption of work. For parents, the questionnaires were administered during Parents’ Teachers Association (PTA) meetings and through home visits. Where respondents had limited literacy, research assistants read out the items in simple English or the local language and recorded the responses without influencing their answers. All completed questionnaires were retrieved immediately. Out of 344 copies distributed, 333 were successfully retrieved and used for analysis, representing a 96.8% return rate.

The data collected were analyzed using both descriptive and inferential statistics with the aid of the Statistical Package for the Social Sciences (SPSS) version 25. Mean and standard deviation were used to answer Research Questions 1, with a criterion mean of 2.50 adopted as the benchmark. One-way Analysis of Variance (ANOVA) was used to answer the research questions 2-4 and test the corresponding null hypotheses at the .05 level of significance in a single table for each hypothesis test. Where significant differences were found, Tukey’s HSD post-hoc test was conducted to identify the specific groups that differed. All assumptions were ascertained, supporting the use of one-way ANOVA: normality was assessed using Shapiro-Wilk tests and visual inspection of Q-Q plots. Homogeneity of variance was tested using Levene’s test. Effect sizes were calculated using partial eta squared.

Results

Research Question 1: What are the levels of awareness, perceptions, utilization, and observed challenges of Artificial Intelligence integration among stakeholders in building construction education in Technical Colleges in Edo State?

Table 1

Descriptive Statistics of Stakeholders' Responses on AI Awareness, Perceptions, Utilization and Observed Challenges in Building Construction Education Technical Colleges in Edo State

	N	Minimum	Maximum	Mean	Std. Deviation
Awareness	333	1.00	4.00	2.5916	.86508
Perception	333	1.00	4.00	3.4625	.59814
Utilization	333	1.00	3.00	1.4865	.61407
Challenges	333	3.00	4.00	3.5976	.49112

Table 1 shows descriptive statistics (N = 333) on stakeholders' awareness, perception, utilization, and observed challenges of AI integration in Building Construction Education in Technical Colleges in Edo State, measured on a 4-point scale. Overall, stakeholders' awareness of AI was moderate (M = 2.59, SD = .87), indicating a basic but uneven level of familiarity, with variability suggesting inconsistent exposure across respondents. In contrast, perception of AI integration was high (M = 3.46, SD = .60), reflecting generally favourable views regarding its relevance and potential, alongside relatively strong agreement among stakeholders.

Despite this positive disposition, utilization of AI was very low (M = 1.49, SD = .61), indicating minimal practical application in teaching and learning and revealing a clear disconnect between awareness and perception and actual implementation. Meanwhile, observed challenges were rated very high (M = 3.60, SD = .49), with strong consensus that significant barriers, likely including infrastructural deficits, inadequate training, limited funding, and low institutional readiness are impeding integration. Collectively, the findings indicate a pronounced imbalance: although stakeholders are positively disposed toward AI and strongly acknowledge existing constraints, actual usage remains minimal. This suggests that AI integration in technical college building construction education in Edo State is still at an early stage, primarily constrained by systemic and practical barriers rather than negative attitudes.

Hypothesis 1: There is no significant difference in awareness of AI integration in building construction education among stakeholders in Technical Colleges in Edo State.

Table 2

One-way ANOVA on Stakeholders' Awareness of AI

Awareness	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	159.780	4	39.945	147.751	.000
Within Groups	88.676	328	.270		
Total	248.456	332			

Note: $\eta^2 = .64$. Tukey HSD: students–teacher (MD = -1.57, $p < .001$); students–administrators (MD = -.79, p

$< .001$); students–employer (MD = -1.49, $p < .001$); teacher–administrators (MD = .78, $p = .011$); teacher–

parents (MD = 1.73, $p < .001$); administrators–parents (MD = .95, $p < .001$); administrators–employer (MD =

-.70, $p = .001$); parents–employer (MD = -1.65, $p < .001$); employer–parents (MD = 1.65, $p < .001$).

The one-way ANOVA in Table 2 revealed a statistically significant difference in stakeholders' awareness of AI integration, $F(4, 328) = 147.75$, $p < .001$, $\eta^2 = .64$. The effect size was large, indicating that 64% of the variance in awareness scores was accounted for by stakeholder group.

Therefore, the null hypothesis was rejected, suggesting that stakeholder group significantly influences awareness of AI integration in building construction education in Technical Colleges in Edo State. The Post hoc analysis using Tukey HSD indicated that differences existed across stakeholder groups, with employers and teachers generally reporting higher awareness than students, administrators, and parents, though with mixed pairwise variations as detailed in the post hoc results.

Hypothesis 2: There is no significant difference in perceptions of AI integration in building construction education among stakeholders in Technical Colleges in Edo State.

Table 3

One-way ANOVA on Stakeholders' Perceptions of AI Integration

Perception	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	27.690	4	6.922	24.926	.000
Within Groups	91.091	328	.278		
Total	118.781	332			

Note: $\eta^2 = .23$. Tukey HSD: students–teacher (MD = .94, $p < .001$); students–administrators (MD = 1.30, $p < .001$); teacher–parents (MD = -.87, $p < .001$); teacher–employer (MD = -1.13, $p < .001$); administrators–parents (MD = -1.23, $p < .001$); administrators–employer (MD = -1.49, $p < .001$); parents–employer (MD = .26, $p = .016$).

The one-way ANOVA in Table 3 revealed a statistically significant difference in stakeholders' perceptions of AI integration, $F(4, 328) = 24.93$, $p < .001$, $\eta^2 = .23$. The effect size indicated that 23% of the variance in perception scores was accounted for by stakeholder group. Therefore, the null hypothesis was rejected, suggesting that stakeholder group significantly influences perceptions of AI integration in building construction education in Technical Colleges in Edo State. Post hoc analysis using Tukey HSD indicated that differences existed across stakeholder groups, with students, parents, and employers generally reporting more favourable perceptions than teachers and administrators, though with mixed pairwise variations as detailed in the post hoc results.

Hypothesis 3: There is no significant difference in the level of utilization of AI among stakeholders in building construction education in Technical Colleges in Edo State.

Table 4

One-way ANOVA on Stakeholders' Level of Utilization of AI

Utilization	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	28.763	4	7.191	24.460	.000
Within Groups	96.426	328	.294		
Total	125.189	332			

Note: $\eta^2 = .64$. Tukey HSD: students–teacher (MD = -1.57, $p < .001$); students–administrators (MD = -.79, $p < .001$); students–employer (MD = -1.49, $p < .001$); teacher–administrators (MD = .78, $p = .011$); teacher–parents (MD = 1.73, $p < .001$); administrators–parents (MD = .95, $p < .001$); administrators–employer (MD = -.70, $p = .001$); parents–employer (MD = -1.65, $p < .001$); employer–parents (MD = 1.65, $p < .001$).

The One-way ANOVA in Table 4 revealed a statistically significant difference in stakeholders' level of utilization of AI, $F(4, 328) = 24.460$, $p < .05$. This indicates that stakeholders differed significantly in their levels of AI utilization. The effect size was large ($\eta^2 = .64$), implying that approximately 64% of the variance in AI utilization was attributable to differences among the stakeholder groups. Consequently, the null hypothesis was rejected. This suggests a substantial practical significance of the observed differences.

The Tukey HSD post hoc test conducted indicated that employers and teachers demonstrated relatively higher levels of AI utilization compared to parents and administrators, while parents consistently recorded the lowest utilization levels. Overall, although the utilization of AI remained generally low across stakeholders, the extent of utilization varied significantly among the groups.

Hypothesis 4: There is no significant difference in the observed challenges of AI integration

among stakeholders in building construction education in Technical Colleges in Edo State.

Table 5: One-way ANOVA on Stakeholders' Observed Challenges of AI Integration

Challenges	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2.179	4	.545	2.294	.059
Within Groups	77.899	328	.237		
Total	80.078	332			

Note: $\eta^2 = .03$, $p > .05$

The ANOVA result in Table 5 reveals a non statistically significant difference among stakeholders regarding their observed challenges associated with AI integration in building construction education in Technical Colleges in Edo State. The result revealed that there was no statistically significant difference among the stakeholder groups in their observed challenges of AI integration in building construction education, $F(4, 328) = 2.294$, $p = .059$. Since the p-value (.059) was greater than the .05 level of significance. Therefore, the null hypothesis was retained. This implies that the stakeholders shared relatively similar views concerning the challenges confronting AI integration in Technical Colleges in Edo State. The effect size analysis further indicated a small magnitude of difference among the groups ($\eta^2 = .027$). This suggests that stakeholder group accounted for only 2.7% of the variance in perceived challenges of AI integration. Consequently, post hoc multiple comparison tests were not conducted because the omnibus ANOVA result was not statistically significant.

Discussion of Findings

Awareness of AI Integration Among Stakeholders

The findings revealed notable disparities in AI awareness across stakeholder groups. Employers demonstrated the highest level of awareness, a finding that aligns with the increasing integration of AI-enabled systems in the construction industry for tasks such as design optimization, predictive maintenance, and risk assessment (Oesterreich & Teuteberg, 2021; Pan & Zhang, 2021). Their direct exposure to digital transformation pressures naturally positions them as the most informed group (McKinsey Global Institute, 2021). Parents also showed relatively high awareness, which contrasts with earlier studies that reported limited parental knowledge of AI in developing contexts (Ifenthaler & Yau, 2020; UNESCO, 2021). This may reflect growing media coverage and community awareness of digital economy demands in Edo State, possibly influenced by recent NBTE initiatives promoting AI in technical colleges (Vanguard News, 2025).

Conversely, teachers and administrators recorded substantially lower awareness. This finding is consistent with the work of Zawacki-Richter et al. (2020) and Bower (2021), who found that

vocational educators often lack sufficient training and institutional support to keep pace with technological change. The wide variability in teachers' responses suggests inconsistent access to professional development across institutions, a pattern also observed by Ifenthaler and Yau (2020). Students, while showing moderate awareness, exhibited considerable variability, indicating that their knowledge of AI may be driven more by personal digital engagement than by formal curriculum exposure (Luckin et al., 2016; Holmes et al., 2019).

Perceptions of AI Integration Among Stakeholders

Students, parents, and employers held significantly more favourable perceptions of AI integration compared to teachers and administrators. Students' positive outlook supports the findings of Ayoola (2025), who reported that AI tools enhance both soft and technical skills among building technology undergraduates. The potential for personalized, adaptive learning experiences such as AI-generated construction tasks tailored to individual proficiency levels (Yi et al., 2024; Yoon et al., 2024) likely appeals to students.

Parents' favourable perceptions, despite their low actual utilization (discussed below), suggest an aspirational or supportive attitude toward AI in education. This deviates from earlier concerns about parental resistance due to job displacement fears (UNESCO, 2021). It may indicate that parents in Edo State recognize the future importance of digital skills, even if they themselves do not currently use AI tools.

In contrast, teachers and administrators held less favourable perceptions, mirroring documented educator resistance to AI adoption. Baker and Smith (2019) and Selwyn (2021) attributed such resistance to fears of professional displacement, inadequate training, and unclear implementation frameworks. Additionally, the hands-on, workshop-based nature of building construction instruction may make teachers more skeptical about the relevance of AI to traditional skill development (Aghimien et al., 2022).

Utilization of AI Integration Among Stakeholders

The most striking finding is the critically low level of AI utilization across all stakeholder groups, despite moderate awareness and favourable perceptions. Employers reported the highest utilization, yet even their mean score remained far below the criterion for meaningful integration. This reflects the nascent state of AI adoption in Nigeria's construction sector, where barriers such as high costs, lack of infrastructure, and limited digital literacy persist (Babatunde et al., 2020; Aghimien et al., 2022).

Teachers and students showed similarly low utilization, with teachers scoring only slightly higher than students. This is concerning because teachers are the primary agents of curriculum delivery; their inability to integrate AI into instruction directly limits students' exposure (Holmes et al., 2019). The lack of significant difference between teachers and employers in utilization, both low, suggests that the education sector is not uniquely lagging; rather, the entire construction ecosystem in Edo State is still transitioning toward AI adoption.

Administrators recorded very low utilization, which aligns with institutional-level constraints identified by the Baker and Smith (2019) and OECD (2021), including insufficient funding, competing priorities, and lack of strategic planning for digital transformation.

Parents recorded the lowest utilization of all groups, with mean scores approaching "strongly disagree." This finding is consistent with Ifenthaler and Yau (2020), who noted that parents in developing contexts often lack direct access to AI technologies due to cost, low digital literacy, and limited relevance to their daily occupations. The wide gap between parents' relatively high awareness and extremely low utilization indicates a failure of technology diffusion to reach households, a critical issue because parental support and home access are known enablers of students' digital learning (UNESCO, 2021).

Collectively, these findings reveal an awareness-utilization paradox: stakeholders know about AI and view it positively, but they do not use it. This gap represents the fundamental barrier to AI integration in building construction education in Edo State.

Observed Challenges of AI Integration

All stakeholder groups strongly and consistently agreed on the existence of substantial barriers to AI integration, with no statistically significant differences in their perceptions of these challenges. This consensus points to systemic, widely recognized obstacles such as inadequate funding, insufficient ICT infrastructure, limited teacher training, rigid curricula, and high implementation costs. These findings mirror those of Aghimien et al. (2022), Babatunde et al. (2020), and Oke et al. (2020), who documented similar barriers in Nigerian construction education and practice.

The near-significant trend ($p = .059$) suggests that with a larger sample or different context, some differences might emerge, for instance, teachers might prioritize pedagogical challenges while administrators focus on financial constraints. Nevertheless, the strong agreement across groups underscores that the challenges are neither hidden nor disputed; rather, the problem lies in translating recognition into action.

Conclusion and Recommendations

This study examined the awareness, perceptions, utilization, and observed challenges of Artificial Intelligence integration in building construction education in state government-owned Technical Colleges in Edo State, Nigeria, drawing on the Unified Theory of Acceptance and Use of Technology (UTAUT). Data from the respondents across five the stakeholder groups (students, teachers, administrators, parents, and employers) revealed a critical and consistent pattern. Stakeholders demonstrated moderate awareness and favourable perceptions of AI, yet actual utilization was universally low. Employers, while the highest utilization, still scored below meaningful integration levels, indicating that AI adoption in Edo State's construction industry remains nascent. Parents, despite moderately high awareness, recorded the lowest utilization, pointing to a profound disconnect between knowing about AI and having practical access or skills to use it. Teachers and students, who are central to the educational process, also showed very low utilization, reflecting a lack of structured curriculum integration and inadequate teacher preparation. Administrators, with the lowest awareness and very low utilization, represent a leadership gap in driving institutional change.

All stakeholder groups strongly concurred on the existence of major barriers, including infrastructure deficits, insufficient funding, limited teacher training, and rigid curricula. The study confirms that stakeholder group significantly influences awareness, perceptions, and utilization, while challenges are perceived similarly across groups.

The overarching conclusion is that Edo State's Technical Colleges face an awareness-utilization paradox and a triple gap: between knowledge and action, between industry expectations and educational outcomes, and between policy rhetoric and classroom reality. Without deliberate, evidence-based interventions that move beyond raising awareness to enabling actual use of AI tools, the building construction workforce will remain ill-prepared for an increasingly digitalized industry.

Based on the findings of this study, the following recommendations were made:

1. Policy Makers should mandate AI utilization benchmarks, fund infrastructure and teacher training, and enforce industry-education partnerships.
2. College Administrators should revise curricula to include hands-on AI modules, establish accessible AI workshops, and undergo leadership training.
3. Teachers should adopt micro-integration of AI tools and form peer learning networks with industry support.

4. Collaboration between college administrators and Parents Teachers Association should be fostered on the basis of community digital literacy classes especially parent-child AI projects with subsidized home access.
5. Employers should provide AI-focused internships, donate equipment and staff time, and join curriculum advisory committees.
6. Researchers should conduct intervention and qualitative studies on utilization barriers and comparative cross-context analyses.
7. Edo State Government should launch a pilot utilization project with monitoring benchmarks and annual recognition awards.

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