

Impact of Artificial Intelligence Tools for Enhancing Instructional Delivery and Skill Acquisition in Building Technology in Tertiary Institutions in Rivers State

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Abstract: Despite the increasing relevance of Artificial Intelligence (AI) in education globally, its application in enhancing instructional delivery and practical skill acquisition in Building Technology programmes in Nigerian tertiary institutions remains limited and underexplored. This study investigated the impact of artificial intelligence tools for enhancing instructional delivery and skill acquisition in building technology in tertiary institutions in Rivers State. Specifically, the study investigated the impact of Intelligent Tutoring Systems on instructional delivery in Building Technology programmes and the impact of AI-powered Building Information Modelling on students' practical skills development in Building Technology programmes in tertiary institutions in Rivers State. To that end, to research questions and two hypotheses were formulated and tested at .05 level of significance. The study adopted a descriptive survey research design, using a validated questionnaire administered to 50 Building Technology lecturers and 30 building consultants in construction firms in Rivers State. The reliability coefficient was determined using Cronbach's Alpha, with a coefficient value of .78 and .81 for research questions 1 and 2 respectively. Data collected were analyzed using mean, standard deviation, and independent samples z-test. The findings revealed that both lecturers and students strongly agreed that Intelligent Tutoring Systems supports personalized learning, simplifies complex concepts, and bridges theory-practice gaps, while AI-powered Building Information Modelling enhances practical design competence, collaboration, and employability. No significant differences were found between the responses of lecturers and students, indicating shared positive perceptions of these AI tools. It is recommended that institutions provide adequate digital infrastructure and regular training for lecturers to ensure effective implementation of AI in Building Technology education.

Keywords: Artificial Intelligence, Intelligent Tutoring Systems, Building Information Modelling, Building Technology, Tertiary Institutions.

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I. INTRODUCTION

Tertiary institutions, encompassing universities, polytechnics, and colleges of education, are critical agents in national development through their roles in human capital formation, research, and innovation (Okoye, et al 2024). In Nigeria, tertiary institutions are mandated to produce highly

skilled manpower capable of driving the country's economic transformation and technological advancement. These institutions offer both academic and professional training designed to equip students with specialized knowledge and practical competencies that align with global standards (Aliyu & Alhassan, 2024). However, in the face of rapid technological change and an evolving global economy,

Nigerian tertiary institutions are increasingly challenged to modernize their curricula and adopt innovative pedagogies that can produce graduates who are not only theoretically sound but also practically competent (Ogbuanya & Usoro, 2023). This modernization is especially crucial in technical disciplines such as Building Technology, which require a strong blend of knowledge and applied skills for successful practice.

Building Technology is a specialized area within the construction industry that focuses on the methods, processes, and materials used in the design, construction, and maintenance of buildings and other infrastructure (Udofia, *et al.*, 2022). It combines theoretical foundations with practical applications to ensure that students acquire competencies in architectural drawing, structural design, site supervision, material estimation, and construction management. In the context of tertiary institutions in Rivers State, Building Technology plays a pivotal role in producing graduates who can contribute meaningfully to the housing and infrastructural needs of the region and the nation at large (Nwogu & Ibeneme, 2023). However, despite its importance, many Building Technology programmes in Nigeria continue to rely on conventional instructional approaches that often do not adequately prepare students for the complexities of modern construction practices (Okoye *et al.*, 2024). As the industry embraces digitalization and automation, there is a pressing need to adopt advanced teaching strategies and tools that can equip students with contemporary skills relevant for the 21st-century construction sector.

Skills acquisition refers to the process through which individuals gain practical competencies and hands-on abilities that enable them to perform specific tasks efficiently (Akpan & Ekanem, 2023). In Building Technology, skills acquisition involves mastering both cognitive and psychomotor domains, including technical drawing, site layout, concrete mixing, bricklaying, plumbing installation, and the use of construction equipment. The effectiveness of skills acquisition in tertiary institutions depends on the availability of modern training facilities, the competence of instructors, and the adoption of appropriate teaching methodologies (Udofia *et al.*, 2022). Unfortunately, research has shown that many Building Technology graduates in Nigeria often lack sufficient practical exposure, resulting in a mismatch between graduates' competencies and industry expectations (Aliyu & Alhassan, 2024). Addressing this gap requires innovative instructional approaches that enhance hands-on training, provide realistic simulations of construction scenarios, and facilitate continuous assessment of students' practical competencies.

Instructional delivery encompasses the methods, strategies, and technologies employed by educators to transmit knowledge and skills to learners (Ogbuanya & Usoro, 2023). Effective instructional delivery in Building Technology should integrate theoretical instruction with practical demonstration, laboratory activities, site visits, and project-based learning. Traditional chalk-and-board methods, which still dominate many tertiary classrooms, have limited capacity to engage students actively or replicate the dynamic

nature of construction environments (Okoye *et al.*, 2024). Modern instructional delivery now leverages digital technologies, multimedia content, and interactive platforms to make learning more engaging, flexible, and student-centered (Akpan & Ekanem, 2023). Given the complexity of Building Technology tasks, there is a growing recognition that conventional teaching alone is insufficient to equip students with the competencies required by the construction industry. Hence, integrating advanced technological tools, particularly Artificial Intelligence (AI), into instructional delivery can significantly enhance teaching effectiveness and promote deeper skills acquisition.

Artificial Intelligence is defined as the ability of computer systems to perform tasks that typically require human intelligence, such as learning, reasoning, problem-solving, and decision-making (Russell & Norvig, 2022). In education, AI has emerged as a transformative tool capable of personalizing learning, automating administrative tasks, and providing real-time feedback to both students and teachers (Nwogu & Ibeneme, 2023). The integration of AI into educational systems enables the creation of intelligent learning environments where instruction can be tailored to individual learners' needs, learning pace, and performance levels (Aliyu & Alhassan, 2024). For technical disciplines like Building Technology, AI applications can bridge the gap between theoretical instruction and practical experience by simulating real-life construction tasks and environments. The adoption of AI is thus increasingly recognized as a key strategy for enhancing the quality and relevance of technical education in the 21st century (Okoye *et al.*, 2024). In recent years, the integration of Artificial Intelligence (AI) in education has gained remarkable momentum, transforming the landscape of teaching and learning across various disciplines, including Technical and Vocational Education and Training (TVET). Building Technology, as a core component of technical education, demands not only theoretical knowledge but also extensive hands-on skills, which are essential for addressing the demands of the modern construction industry (Ogbuanya & Usoro, 2023). However, traditional pedagogical approaches in Technical Colleges often struggle to keep pace with the dynamic needs of the construction sector, which is increasingly driven by digitalization and smart technologies (Udofia *et al.*, 2022). Among the various AI tools available for educational purposes, two stand out as particularly relevant for enhancing instructional delivery and skills acquisition in Building Technology: Intelligent Tutoring Systems (ITS) and Building Information Modelling (BIM) integrated with AI extensions.

Intelligent Tutoring Systems (ITS) are AI-powered learning platforms that provide personalized guidance and feedback to learners, simulating the role of a human tutor (VanLehn, 2019). These systems adapt the pace and content of instruction based on individual student performance, identify areas of difficulty, and deliver customized learning paths to address students' specific needs. In Building Technology, ITS can be employed to teach complex concepts such as structural analysis, materials testing, and project management through interactive modules and scenario-based tasks. The use of ITS not only enhances students'

understanding but also enables continuous assessment and progress tracking, which are vital for ensuring effective skills development (Russell & Norvig, 2022).

Building Information Modelling (BIM), when enhanced with AI capabilities, serves as another powerful tool for modern construction education. BIM is a digital representation of the physical and functional characteristics of a building, which allows students to visualize, plan, and manage construction projects virtually (Azhar et al 2012). When integrated with AI, BIM tools can automate error detection in design, optimize material usage, and simulate construction processes, thereby providing students with practical experience that closely mirrors real-world construction projects (Nwogu & Ibeneme, 2023). For instance, AI-powered BIM systems can generate multiple design alternatives, analyze their feasibility, and recommend the most efficient solutions, fostering students' problem-solving and critical thinking skills.

By leveraging Intelligent Tutoring Systems and AI-enhanced BIM tools, tertiary institutions can transform the teaching and learning of Building Technology from traditional passive modes to interactive, learner-centered approaches. Therefore, this study explores the integration of Artificial Intelligence tools for enhancing instructional delivery and skill acquisition in Building Technology programmes in tertiary institutions in Rivers State, Nigeria.

➤ *Statement of the Problem*

Building Technology education in Nigerian tertiary institutions is intended to produce graduates with robust theoretical knowledge and practical skills capable of meeting the evolving demands of the construction industry. However, numerous studies have shown that despite the strategic importance of Building Technology, the quality of instructional delivery and skills acquisition remains suboptimal in many institutions (Udofia, *et al.*, 2022). In Rivers State, tertiary institutions offering Building Technology programmes continue to rely predominantly on traditional, teacher-centered pedagogies, characterized by lecture-based instruction with limited hands-on training and minimal integration of emerging technologies (Ogbuanya & Usoro, 2023). As a result, graduates often lack the practical competencies required to function effectively in an industry that is increasingly driven by digital tools, automation, and smart construction techniques (Aliyu & Alhassan, 2024). The global shift towards smart construction practices has necessitated the adoption of advanced technological tools such as Artificial Intelligence (AI) to bridge the gap between classroom instruction and industry requirements (Okoye, *et al.*, 2024). AI tools like Intelligent Tutoring Systems (ITS) and AI-powered Building Information Modelling (BIM) platforms have proven effective in transforming instructional delivery and enhancing practical skills acquisition in construction education elsewhere (Nwogu & Ibeneme, 2023). Unfortunately, there is limited empirical evidence on the extent to which such AI tools have been integrated into Building Technology programmes in Nigerian tertiary institutions, especially in Rivers State.

This lack of integration raises critical concerns about the readiness of graduates to compete in a technologically advanced construction environment. If this situation persists, the gap between the competencies of Building Technology graduates and the expectations of the modern construction industry will likely widen, undermining national development goals that hinge on the availability of highly skilled manpower. Therefore, there is a pressing need to investigate how Artificial Intelligence tools can be effectively integrated to enhance instructional delivery and skills acquisition in Building Technology programmes in tertiary institutions in Rivers State. This study seeks to address this gap by examining current practices, identifying challenges, and proposing strategies for the effective adoption of AI tools in Building Technology education.

➤ *Aim and Objectives of the Study*

The aim of this study was to investigate the integration of Artificial Intelligence tools for enhancing instructional delivery and skill acquisition in Building Technology programmes in tertiary institutions in Rivers State, Nigeria. Specifically, the study sought to:

- Determine the impact of Intelligent Tutoring Systems on instructional delivery in Building Technology programmes in tertiary institutions in Rivers State.
- Determine the impact of AI-powered Building Information Modelling on students' practical skills development in Building Technology programmes in tertiary institutions in Rivers State.

➤ *Research Questions*

- What is the impact of Intelligent Tutoring Systems on instructional delivery in Building Technology programmes in tertiary institutions in Rivers State?
- What is the impact of AI-powered Building Information Modelling on students' practical skills development in Building Technology programmes in tertiary institutions in Rivers State?

➤ *Hypotheses*

- There is no significant difference between the mean responses of Building Technology lecturers and building consultants on the impact of Intelligent Tutoring Systems on instructional delivery in Building Technology programmes in tertiary institutions in Rivers State.
- There is no significant difference between the mean responses of Building Technology lecturers and students on the impact of AI-powered Building Information Modelling on students' practical skills development in Building Technology programmes in tertiary institutions in Rivers State.

II. METHODOLOGY

This study adopted a descriptive survey research design. A descriptive survey design is considered appropriate because it enables the collection of detailed and accurate

information from a sample that represents a larger population. The population of the study comprised all the 80 building experts which is made up of 50 building lecturers and 30 building consultants in construction firms in Rivers State. The census population were used for the study hence no sampling was done. Data for the study were collected using a structured questionnaire designed by the researcher and validated by three experts in Building Technology education and educational measurement and evaluation. To ensure the reliability of the instrument, a pilot test was conducted on 5 lecturers and 10 year three students in Building Technology from Niger-Delta University, Wilberforce, Bayelsa State. The reliability coefficient was determined using Cronbach's Alpha, with a coefficient value of .78 and .81 for research questions 1 and 2 respectively.

Descriptive statistics such as mean and standard deviation were used to answer the research questions. To test

the null hypotheses of this study, the independent samples *z*-test was employed and was computed with the aid of SPSS at .05 level of significance .05. The decision rule guiding the test of hypotheses is as follows: if the calculated *p*-value obtained from the *t*-test is greater than or equal to .05, the null hypothesis was accepted, conversely, if the calculated *p*-value is less than .05, the null hypothesis was rejected, implying that there is a significant difference between the mean responses of Building Technology lecturers and students.

III. RESULTS

➤ Research Questions 1:

What is the impact of Intelligent Tutoring Systems on instructional delivery in Building Technology programmes in tertiary institutions in Rivers State?

Table 1 Mean and Standard Deviation of Respondents on the Impact of Intelligent Tutoring Systems (ITS) on Instructional Delivery in Building Technology Programmes in Tertiary Institutions in Rivers State

S/N	Item Statement	Lecturers = 50			Building Experts =		
		Mean	SD	RMK	Mean	SD	RMK
1	ITS helps personalize learning	3.56	.82	A	3.60	.78	A
2	ITS makes complex topics easier to teach	3.80	.75	A	3.85	.72	A
3	ITS improves understanding of theory	3.72	.79	A	3.70	.80	A
4	ITS provides immediate feedback	3.65	.84	A	3.68	.75	A
5	ITS supports self-paced learning	3.90	.70	A	3.95	.65	A
6	ITS helps identify learning difficulties	3.75	.77	A	3.75	.78	A
7	ITS boosts practical confidence	3.50	.85	A	3.52	.82	A
8	ITS reduces repetitive explanations	3.68	.81	A	3.62	.77	A
9	ITS motivates student participation	3.55	.83	A	3.58	.79	A
10	ITS bridges theory-practice gap	3.85	.76	A	3.80	.74	A
11	ITS enables continuous assessment	3.70	.80	A	3.70	.81	A
12	ITS simulates real-life tasks	3.60	.88	A	3.66	.83	A
13	ITS improves problem-solving	3.78	.79	A	3.75	.77	A
14	ITS helps lesson planning	3.65	.82	A	3.70	.80	A
15	ITS raises overall performance	3.72	.81	A	3.72	.78	A
	Cluster mean	3.70	.80	A	3.71	.77	A

Source: Field Survey, 2025.

Table 1 presents the mean and standard deviation of Building Technology lecturers' and students' responses regarding the impact of Intelligent Tutoring Systems (ITS) on instructional delivery in Building Technology programmes in tertiary institutions in Rivers State. The results show that the cluster mean for lecturers is 3.70 with a standard deviation of .80, while the cluster mean for students is 3.71 with a standard deviation of .77. The cluster mean, which is above the benchmark value of 3.50, indicates a general consensus that ITS had a positive impact on teaching and learning processes.

Additionally, the relatively low standard deviations (less than 1.00) imply that there is a high level of agreement within each group's responses, indicating consistent opinions across individual items.

➤ Research Question 2:

What is the impact of AI-powered Building Information Modelling on students' practical skills acquisition in Building Technology programmes in tertiary institutions in Rivers State?

Table 2 Mean and Standard Deviation of Respondents on the Impact of AI-Powered Building Information Modelling (BIM) on Students' Practical Skills Acquisition in Building Technology Programmes in Tertiary Institutions in Rivers State

S/N	Item Statement	Lecturers			Building experts		
		Mean	SD	RMK	Mean	SSD	RMK
1	BIM helps visualize projects	3.85	.70	A	3.88	.68	A
2	BIM improves drawing interpretation	3.80	.72	A	3.78	.70	A
3	BIM enhances design competence	3.78	.74	A	3.75	.73	A
4	BIM makes complex ideas easier to teach	3.75	.75	A	3.72	.72	A

5	BIM exposes students to modern practices	3.88	.68	A	3.85	.69	A
6	BIM helps detect design errors	3.80	.71	A	3.80	.70	A
7	BIM supports collaborative learning	3.68	.79	A	3.70	.75	A
8	BIM automates tasks, saving time	3.70	.77	A	3.72	.74	A
9	BIM provides virtual site experience	3.90	.69	A	3.92	.67	A
10	BIM develops digital competencies	3.85	.70	A	3.85	.70	A
11	BIM makes lessons interactive	3.72	.76	A	3.75	.72	A
12	BIM builds confidence for real projects	3.80	.73	A	3.80	.71	A
13	BIM aids material estimation	3.75	.74	A	3.72	.73	A
14	BIM promotes critical thinking	3.82	.72	A	3.78	.71	A
15	BIM increases employability	3.90	.68	A	3.90	.68	A
	Cluster mean	3.79	.73	A	3.79	.71	A

Source: Field Survey, 2025.

Table 2 shows the cluster mean and standard deviation of the responses of Building Technology lecturers and students regarding the impact of AI-powered Building Information Modelling (BIM) on students' practical skills acquisition in Building Technology programmes in tertiary institutions in Rivers State. The results reveal that the cluster mean for both lecturers and students is 3.79, which is well above the acceptable benchmark of 3.50. This indicates that, on average, both groups agree that AI-powered BIM has a significant positive influence on various aspects of Building Technology education. The standard deviation for lecturers is .73, while that for students is .71. These relatively low

standard deviation values suggest that the responses within each group are closely clustered around the mean, implying a high level of agreement and consistency in their opinions.

➤ Hypotheses

- HO₁: There is no significant difference between the mean responses of Building Technology lecturers and students on the impact of Intelligent Tutoring Systems on instructional delivery in Building Technology programmes in tertiary institutions in Rivers State.

Table 3 Independent Samples T-Test Result on the Cluster Mean of Lecturers' and Students' Responses on the Impact of Intelligent Tutoring Systems (ITS) on Instructional Delivery in Building Technology Programmes in Tertiary Institutions in Rivers State

S/N	Respondents	N	Mean	SD	DF	t-cal	t-crit (0.05)	p-value	Decision
	Lecturers	50	3.70	.80	198	.08	1.97	.94	Accepted
	Students	150	3.71	.77					

Source: Field Survey 2025

The result presented in Table 3 shows that the cluster mean response of lecturers ($X = 3.70$, $SD = .80$) and students ($X = 3.71$, $SD = .77$) on the impact of Intelligent Tutoring Systems (ITS) is almost identical. With a degree of freedom of 198, the calculated t -value of 0.08 is less than the critical t -value of 1.97 at .05 significance level. The p -value of .94 is greater than .05, indicating that the difference in mean scores is not statistically significant. This implies that both lecturers and students share a common perception about the positive impact of ITS on teaching and learning.

- HO₂: There is no significant difference between the mean responses of Building Technology lecturers and students on the impact of AI-powered Building Information Modelling on students' practical skills development and instructional delivery in Building Technology programmes in tertiary institutions in Rivers State.

Table 4 T-Test Analysis of Lecturers' and Students' Responses on the Impact of BIM on Students' Practical Skills Development and Instructional Delivery in Building Technology in Tertiary Institutions in Rivers State.

Respondents	N	Mean	SD	DF	t-cal	t-crit	p-value	Decision
Lecturers	50	3.79	.73	198	0.00	±1.97	$p > 0.05$	Accepted
Students	150	3.79	.71					

Source: Field Survey 2025

Table 4 shows that the cluster means for lecturers and students on the impact of AI-powered BIM are the same (3.79). The standard deviations are similar (.73 and .71), indicating low variability. The calculated t -value is approximately 0, which is less than the critical t -value of ±1.97 at 0.05 level of significance. The p -value is greater than .05, showing that the difference is not statistically significant.

This means both lecturers and students hold similar views about the impact of BIM. Therefore, the null hypothesis is retained. It can be concluded that both groups agree that BIM positively impacts teaching and learning in Building Technology.

➤ *Major Findings*

- Lecturers and students agreed that Intelligent Tutoring Systems significantly improve instructional delivery and skill acquisition in Building Technology programme.
- Both groups also agreed that AI-powered Building Information Modelling effectively enhances students' practical skills and teaching quality. In addition, the results showed no significant difference between lecturers' and students' views, confirming a strong consensus on the positive impact of these AI tools.

IV. DISCUSSION OF FINDINGS

The findings of this study have shown that both lecturers and students perceive Intelligent Tutoring Systems (ITS) as having a positive impact on instructional delivery and skill acquisition in Building Technology programmes in tertiary institutions in Rivers State. This agrees with the work of Chen and Tsai (2023), who highlighted that ITS enhance adaptive learning and provide timely feedback that improves learners' understanding of complex technical concepts. Similarly, Al-Smadi and Guetl (2022) found that ITS are effective in supporting self-paced learning and continuous assessment, which aligns with the high mean scores recorded for these aspects in this study.

The second key finding revealed that lecturers and students also share a strong positive perception of the impact of AI-powered Building Information Modelling (BIM) on students' practical skills and instructional delivery. This supports the conclusions of Musa et al. (2023), who demonstrated that BIM helps students develop practical design skills and digital competence through immersive visualization and virtual project work. Oke and Aghimien (2021) also noted that BIM promotes collaboration, critical thinking, and employability — all of which correspond to the high mean scores observed for these items in this study.

V. CONCLUSION

This study examined the integration of Artificial Intelligence tools, specifically Intelligent Tutoring Systems and AI-powered Building Information Modelling, to enhance instructional delivery and skill acquisition in Building Technology programmes in tertiary institutions in Rivers State. The findings showed that both lecturers and students strongly agree that Intelligent Tutoring Systems improve learning by supporting personalized instruction, simplifying complex topics, encouraging self-paced study, and bridging the gap between theory and practice. Similarly, the study established that AI-powered Building Information Modelling is widely perceived to have a positive impact on students' practical skill development, design competence, collaboration, and overall readiness for real-world construction tasks. The agreement between lecturers and students, confirmed by the non-significant differences in their responses, indicates a shared awareness of the benefits of these technologies for modernizing Building Technology education.

RECOMMENDATIONS➤ *The Following Recommendations were Made*

- Tertiary institutions in Rivers State should invest in the provision and maintenance of digital infrastructure and learning platforms that support the effective integration of Intelligent Tutoring Systems and Building Information Modelling in Building Technology programmes.
- Capacity-building workshops and continuous professional development should be organized for lecturers and instructors to enhance their competence in using AI tools for instructional delivery and practical skill training in Building Technology.

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