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INTEGRATING TECHNOLOGY IN EDUCATION: A CATALYST FOR ENHANCED LEARNING OUTCOMES IN SECONDARY SCHOOLS IN ABUJA MUNICIPAL AREA COUNCIL (AMAC), FEDERAL CAPITAL TERRITORY, NIGERIA

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ABSTRACT
This study examined the integration of technology in education and its influence on learning outcomes among secondary school students in Abuja Municipal Area Council (AMAC), Federal Capital Territory, Nigeria. The study was motivated by the increasing adoption of digital technologies in teaching and learning and the need to determine whether their classroom application contributes to improved educational outcomes in Nigerian secondary schools. A descriptive survey research design was adopted for the study. The target population comprised 24,850 senior secondary school students (SS1–SS3) across public and private secondary schools in AMAC, from which a sample of 400 respondents was selected using a multistage sampling technique. Data were collected using a structured questionnaire titled Technology Integration and Student Learning Outcomes Questionnaire (TISLOQ), which was validated by three experts and yielded a Cronbach's alpha reliability coefficient of 0.84. The data collected were analysed using descriptive statistics (mean and standard deviation) and simple linear regression analysis at the 0.05 level of significance. The findings revealed that technology is integrated into teaching and learning to a high extent (grand mean = 2.92, SD = 0.86), and that technology integration has a high positive influence on students' learning outcomes (grand mean = 3.16, SD = 0.76). Furthermore, regression analysis established that technology integration significantly influences students' learning outcomes ($R = 0.684$, $R^2 = 0.468$, $F = 350.12$, $p < 0.05$). The study concludes that effective integration of digital technology enhances teaching and learning when appropriate infrastructure, teacher competence, student access, and institutional support are available. It recommends that secondary schools in AMAC improve access to relevant digital resources, strengthen teachers' technological and pedagogical competencies, and provide adequate technical and institutional support to promote sustainable technology-assisted learning.

Keywords: Digital Technology, Learning Outcomes, Secondary Schools,

Introduction

The integration of technology into education has become an important component of contemporary teaching and learning. Digital technologies such as computers, smartphones, tablets, projectors, interactive learning platforms, educational applications, internet resources, and learning management systems have transformed the ways teachers present instructional materials and the ways students access, process, and communicate knowledge. However, the educational value of technology does not depend simply on the physical availability of digital devices. Rather, it depends on how effectively such technologies are integrated into classroom instruction, teachers' competence in using them, students' access to digital resources, the availability of reliable electricity and internet connectivity, and the institutional support provided by schools. Consequently, technology integration in education must be examined within the specific social, economic, and institutional context in which teaching and learning take place.

Aboderin (2025), in an analysis of information and communication technology (ICT) integration in Nigerian secondary schools, observed that ICT implementation remains uneven and that a substantial gap persists between policy aspirations and the practical realities of technology deployment in schools. Aboderin (2025) emphasised the importance of addressing the digital divide, teacher training, and institutional support if technology is to produce sustainable educational benefits. The Nigerian context is particularly critical because technology integration cannot be assumed to operate uniformly across all geographical areas and school systems. Differences in school ownership, availability of facilities, socioeconomic conditions, teacher competence, and administrative support can determine whether digital technology becomes an effective instructional resource or remains underutilised equipment. Similarly, Guobadia et al. (2024) examined digital learning culture across secondary schools in Nigeria, including the Federal Capital Territory (FCT), Abuja, involving 2,220 students and 740 teachers from 111 secondary schools, demonstrating the necessity of evaluating technology use within the actual operational realities of Nigerian secondary education.

The educational landscape in the Federal Capital Territory (FCT), Abuja, provides a compelling setting for examining technology integration because Abuja is Nigeria's administrative capital and contains a diverse mixture of public and private educational institutions with varying levels of educational resources and technological capacity. Within the FCT, schools are increasingly exposed to digital approaches to teaching and learning, yet access and utilisation are far from uniform. Olowonefa (2022) investigated the impact of ICT on public secondary school administration in the FCT, Abuja, identifying inadequate ICT facilities, unstable internet services, erratic electricity supply, inadequate ICT knowledge, insufficient funding, high costs of facilities, and weak implementation of ICT policies as major constraints. These findings are directly relevant to the present study because the same infrastructural and human-capacity conditions that affect school administration also shape the extent to which teachers and students can use technology effectively for classroom learning.

Focusing specifically on Abuja Municipal Area Council (AMAC) allows the investigation to move beyond broad national generalisations and examine classroom realities within this core administrative district of the FCT. Yusuf, Umar Kari, and Yahaya (2025) examined technology integration and learning outcomes across 40 public and private secondary schools in AMAC, reporting that although many schools had introduced basic technologies such as computers, projectors, and tablets, their regular use in classroom instruction remained

inconsistent. Nevertheless, students reported improved academic performance and heightened interest, particularly in science and mathematics, when visual aids and interactive digital platforms were utilised. In a follow-up investigation of adoption barriers within AMAC, Yusuf, Umar Kari, and Yahaya (2026) confirmed that inadequate digital devices, poor internet connectivity, insufficient teacher training, lack of technical support, and disparities between public and private schools continued to constrain sustained classroom integration.

Comparable evidence across nearby Nigerian jurisdictions reinforces these patterns. Chukwuemeka and Aregbesola (2025) investigated secondary school teachers' proficiency in integrating technology within their subject-matter contexts in Gwagwalada Area Council, FCT Abuja, demonstrating that teachers' ability to align digital tools with specific subject pedagogy is a decisive factor in successful implementation. Likewise, Idris and Umar (2025) examined ICT integration in basic and secondary schools in Niger State and found significantly higher mean achievement outcomes in schools utilising ICT compared with those without ICT, alongside notable gains in student engagement, comprehension, and retention. Furthermore, the COVID-19 pandemic underscored the strategic necessity of sustainable digital readiness; schools with established infrastructure and digitally competent teachers maintained instructional continuity during physical closures, whereas under-resourced schools suffered severe disruptions (Federal Ministry of Education, 2021).

Theoretically, this study is anchored on the Technology Acceptance Model (TAM) propounded by Davis (1989) and complemented by the Technological Pedagogical Content Knowledge (TPACK) framework developed by Mishra and Koehler (2006). Davis (1989) posited that user acceptance of technology is governed primarily by two cognitive beliefs: perceived usefulness (the degree to which an individual believes using a system enhances job performance) and perceived ease of use (the degree to which using the system is free from effort). While TAM explains why teachers and students adopt or resist available digital tools based on usability and institutional support, Mishra and Koehler (2006) demonstrated through the TPACK framework that effective classroom technology integration requires the dynamic intersection of three core knowledge domains: content knowledge (CK), pedagogical knowledge (PK), and technological knowledge (TK). Simply placing computers or projectors in AMAC classrooms does not guarantee improved learning outcomes unless teachers possess the TPACK competence to transform subject content pedagogically using digital tools and perceive those tools as reliable and useful within their instructional environment.

Statement of the problem

The integration of technology into education has become increasingly vital for enhancing instructional quality in secondary schools. When appropriately integrated into classroom activities, digital tools such as computers, laptops, tablets, projectors, interactive boards, educational applications, and online platforms can deepen students' conceptual understanding, stimulate motivation, encourage active participation, and elevate academic achievement. However, the mere presence of technological hardware in schools does not automatically translate into improved learning outcomes. Educational effectiveness depends on consistent classroom utilisation, teacher pedagogical-technological competence, equitable student access, reliable power supply, stable internet connectivity, and sustained institutional support.

This challenge is particularly acute in the Federal Capital Territory, Abuja, where secondary schools operate amid wide disparities in infrastructure, school ownership, socioeconomic status, and technical capacity. Although Abuja enjoys greater exposure to technological innovation than many regions in Nigeria, access across schools in Abuja Municipal

Area Council (AMAC) remains uneven. Some schools possess computers and projectors but suffer from erratic electricity and weak internet connectivity, whereas others have functional facilities but lack teachers adequately trained to integrate digital tools into subject instruction. Consequently, technology is often used sporadically or merely as a passive substitute for traditional chalkboards rather than as an interactive catalyst for active learning. Given this implementation gap between device availability and meaningful classroom integration, this study sought to empirically determine the extent of technology integration and its actual influence on students' learning outcomes in secondary schools in AMAC, FCT, Nigeria.

Purpose of the study

The purpose of this study was to examine the integration of technology in education as a catalyst for enhanced learning outcomes in secondary schools in Abuja Municipal Area Council (AMAC), Federal Capital Territory, Nigeria. Specifically, the study sought to:

i. examine the extent to which technology is integrated into teaching and learning processes in secondary schools in Abuja Municipal Area Council (AMAC), Federal Capital Territory, Nigeria;
ii. determine the influence of technology integration on the learning outcomes of secondary school students in Abuja Municipal Area Council (AMAC), Federal Capital Territory, Nigeria.

Research questions

The study was guided by the following research questions:

i. To what extent is technology integrated into teaching and learning processes in secondary schools in Abuja Municipal Area Council (AMAC), Federal Capital Territory, Nigeria?
ii. What is the influence of technology integration on the learning outcomes of secondary school students in Abuja Municipal Area Council (AMAC), Federal Capital Territory, Nigeria?

Hypothesis

The following null hypothesis was formulated and tested at the 0.05 level of significance:

H_{01}: Technology integration has no significant influence on the learning outcomes of secondary school students in Abuja Municipal Area Council (AMAC), Federal Capital Territory, Nigeria.

Methodology

The study adopted a descriptive survey research design, which was deemed appropriate for systematically investigating the extent of technology integration and its influence on learning outcomes among secondary school students in Abuja Municipal Area Council (AMAC), Federal Capital Territory, Nigeria. This design enabled the researcher to collect quantitative data from a representative sample of students regarding the availability, accessibility, frequency of use of digital technologies, and perceived learning outcomes across participating schools.

The target population of the study comprised 24,850 Senior Secondary School students (SS1–SS3) enrolled across accredited public and private secondary schools in AMAC during the 2025/2026 academic session, based on records obtained from the FCT Secondary Education Board (SEB) and the Department of Quality Assurance. Using Taro Yamane's (1967) sample size determination formula at a 0.05 margin of error, a minimum sample of 394 was calculated and rounded up to 400 students to account for potential attrition and ensure robust statistical power. A multistage sampling technique was employed to select the respondents. First, secondary schools in AMAC were stratified by ownership into public and private schools. Second, 20 secondary schools (10 public and 10 private) were selected using simple random

sampling. Third, 20 Senior Secondary School students were randomly selected from each of the 20 schools using stratified random sampling across SS1, SS2, and SS3 classes, yielding a total sample of 400 students.

Data were collected using a researcher-developed structured questionnaire titled Technology Integration and Student Learning Outcomes Questionnaire (TISLOQ). The instrument was divided into three sections: Section A elicited demographic information of the respondents; Section B contained six items measuring the extent of technology integration in teaching and learning (covering computers, projectors/multimedia, internet resources, student digital devices, online educational platforms, and educational applications); and Section C contained six items assessing students' learning outcomes (covering lesson comprehension, interest and motivation, classroom participation, knowledge retention, academic performance, and independent learning). Items in Sections B and C were structured on a modified four-point Likert-type rating scale of Very High Extent / Strongly Agree (4 points), High Extent / Agree (3 points), Low Extent / Disagree (2 points), and Very Low Extent / Strongly Disagree (1 point).

The instrument was subjected to face and content validation by three experts: two in Educational Technology and one in Measurement and Evaluation from the University of Abuja. Their observations regarding item clarity, relevance, and alignment with the research objectives were incorporated into the final version of the questionnaire. To establish internal consistency, a pilot test was conducted with 40 senior secondary school students in Bwari Area Council, FCT, who shared similar characteristics with the study population but were excluded from the main study. Data from the pilot study were analysed using Cronbach's alpha, yielding reliability coefficients of 0.82 for Section B, 0.86 for Section C, and an overall reliability index of 0.84, confirming that the instrument was reliable for the study.

The researcher, assisted by two trained research assistants, administered 400 copies of the questionnaire directly to the sampled students in their respective schools after obtaining formal permission from the FCT Secondary Education Board and the principals of the participating schools. All 400 copies were properly completed and retrieved on the spot, representing a 100% response rate. Data collected were analysed using descriptive and inferential statistics via the Statistical Package for the Social Sciences (SPSS, Version 27). Specifically, mean and standard deviation were used to answer the two research questions based on a real-limit decision rule on the four-point scale: mean scores of 3.50–4.00 = Very High Extent/Influence, 2.50–3.49 = High Extent/Influence, 1.50–2.49 = Low Extent/Influence, and 1.00–1.49 = Very Low Extent/Influence (with 2.50 serving as the criterion benchmark for high vs. low extent/influence). Simple linear regression analysis was used to test the null hypothesis at the 0.05 level of significance. Ethical standards were strictly observed throughout the research: institutional approvals were secured, informed consent and assent were obtained, participation was entirely voluntary, and respondents' anonymity and confidentiality were guaranteed.

Results

Research question one

To what extent is technology integrated into teaching and learning processes in secondary schools in Abuja Municipal Area Council (AMAC), Federal Capital Territory, Nigeria?

Table 1: Mean and Standard Deviation of the Extent of Technology Integration in Teaching and Learning

S/N	Items on Technology Integration	N	Mean ($\bar{X}$)	SD	Decision
1	Computers are regularly used to support classroom teaching.	400	3.21	0.76	High Extent

S/N	Items on Technology Integration	N	Mean ($\bar{X}$)	SD	Decision
2	Projectors and multimedia resources are used during lessons.	400	3.08	0.81	High Extent
3	Teachers use internet resources to supplement classroom instruction.	400	2.96	0.87	High Extent
4	Students use digital devices to access educational materials.	400	2.89	0.91	High Extent
5	Online educational platforms are incorporated into teaching and learning.	400	2.61	0.94	High Extent
6	Educational applications and digital learning resources are regularly used.	400	2.74	0.89	High Extent
	Grand Mean	**400**	**2.92**	**0.86**	**High Extent**

Decision Rule: *Mean scores of 2.50 and above = High Extent, while mean scores below 2.50 = Low Extent, based on a four-point rating scale.*

Interpretation

Table 1 shows that technology is integrated into teaching and learning processes in secondary schools in AMAC to a high extent, as indicated by the grand mean of 2.92 (SD = 0.86), which exceeds the 2.50 decision benchmark. All six items recorded mean scores above 2.50 and therefore fall within the High Extent category under the study's decision rule. The highest mean score of 3.21 (SD = 0.76) was recorded for the use of computers to support classroom teaching, indicating that computers constitute the most commonly utilised technological resource in the schools. The use of projectors and multimedia resources recorded a mean of 3.08 (SD = 0.81), internet resources to supplement classroom instruction recorded a mean of 2.96 (SD = 0.87), and students' use of digital devices to access educational materials recorded a mean of 2.89 (SD = 0.91). Although educational applications and digital learning resources (mean = 2.74, SD = 0.89) and online educational platforms (mean = 2.61, SD = 0.94) also satisfied the criterion for a high extent of integration, their lower relative means compared with hardware tools indicate that schools rely more heavily on standalone computers and projectors than on internet-dependent learning platforms.

Research question two

What is the influence of technology integration on the learning outcomes of secondary school students in Abuja Municipal Area Council (AMAC), Federal Capital Territory, Nigeria?

Table 2: Mean and Standard Deviation of the Influence of Technology Integration on Students' Learning Outcomes

S/N	Learning Outcome Indicators	N	Mean ($\bar{X}$)	SD	Decision
1	Technology improves students' understanding of lesson content.	400	3.24	0.71	High Influence
2	Technology increases students' interest and motivation to learn.	400	3.18	0.75	High Influence
3	Technology improves students' classroom participation.	400	3.12	0.78	High Influence
4	Technology helps students retain information for longer periods.	400	3.05	0.82	High Influence
5	Technology contributes to improved academic performance.	400	3.16	0.77	High Influence

S/N	Learning Outcome Indicators	N	Mean ($\bar{X}$)	SD	Decision
6	Technology encourages independent learning and access to information.	400	3.20	0.73	High Influence
	Grand Mean	**400**	**3.16**	**0.76**	**High Influence**

Decision Rule: *Mean scores of 2.50 and above = High Influence, while mean scores below 2.50 = Low Influence, based on a four-point rating scale.*

Interpretation

Table 2 indicates that technology integration has a high positive influence on the learning outcomes of secondary school students in AMAC, as demonstrated by the grand mean of 3.16 (SD = 0.76). Specifically, respondents rated improved understanding of lesson content highest (mean = 3.24, SD = 0.71), followed closely by encouragement of independent learning and access to information (mean = 3.20, SD = 0.73), increased interest and motivation to learn (mean = 3.18, SD = 0.75), improved academic performance (mean = 3.16, SD = 0.77), improved classroom participation (mean = 3.12, SD = 0.78), and longer retention of information (mean = 3.05, SD = 0.82). Across all measured indicators, the consistently high mean scores and moderate standard deviations demonstrate strong consensus among students that technology-enhanced instruction improves cognitive engagement, active participation, and overall academic achievement.

Hypothesis one

H_{01}: Technology integration has no significant influence on the learning outcomes of secondary school students in Abuja Municipal Area Council (AMAC), Federal Capital Territory, Nigeria.

Table 3: Simple Linear Regression Analysis of the Influence of Technology Integration on Learning Outcomes

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	F	Sig. (p)
1	0.684	0.468	0.467	0.421	350.12	0.000

Dependent Variable: Learning Outcomes | Predictor: Technology Integration | N = 400 | Significance level = 0.05

Interpretation

Table 3 presents the simple linear regression analysis conducted to determine whether technology integration has a statistically significant influence on the learning outcomes of secondary school students in AMAC. The model yielded a correlation coefficient (R) of 0.684, indicating a strong positive linear relationship between technology integration and learning outcomes. The coefficient of determination (R^2 = 0.468; Adjusted R^2 = 0.467) shows that technology integration accounts for 46.8% of the variance in students' learning outcomes, while the remaining 53.2% is attributable to other pedagogical, institutional, and learner-related factors outside the model. Furthermore, the analysis of variance for the regression yielded $F(1, 398) = 350.12$, $p = 0.000$. Because $p < 0.05$, the null hypothesis (H_{01}) is rejected, confirming that technology integration exerts a statistically significant positive influence on students' learning outcomes in AMAC secondary schools.

Discussion of findings

The findings from the first research question demonstrate that while digital technologies are integrated to a high overall extent across secondary schools in Abuja Municipal Area Council, adoption is noticeably asymmetrical across tool categories. Hardware infrastructure—

specifically desktop computers and multimedia projectors—experiences widespread classroom deployment, whereas interactive online learning platforms and specialised educational software lag behind. Interpreted through Davis's (1989) Technology Acceptance Model (TAM), this divergence suggests that teachers and students readily adopt offline presentation hardware whose immediate instructional utility is clear and whose operation is relatively straightforward, but exhibit lower adoption of cloud-based platforms whose perceived ease of use is undermined by unstable internet bandwidth and unreliable electricity. These empirical patterns align closely with Yusuf, Umar Kari, and Yahaya (2025, 2026), who documented that secondary schools in AMAC have acquired basic digital hardware yet struggle with consistent daily integration of internet-enabled instructional systems due to infrastructural bottlenecks and maintenance deficits. Similarly, Olowonefa (2022) and Aboderin (2025) observed that infrastructural instability and uneven resource distribution across FCT and Nigerian secondary schools frequently restrict technology use to basic instructional delivery rather than full digital ecosystem integration.

With respect to the second research question, the findings reveal that students perceive technology integration as exerting a powerful positive impact on multiple dimensions of learning, most notably conceptual comprehension, self-directed inquiry, academic motivation, and knowledge retention. Visualisations, multimedia demonstrations, and interactive digital materials enable learners to decode abstract concepts more effectively than passive lecture methods alone. These outcomes corroborate the findings of Idris and Umar (2025) in Niger State and Guobadia et al. (2024) across Nigerian secondary schools, both of which established that purposeful classroom technology integration elevates student engagement, deeper cognitive processing, and academic achievement. Viewed through Mishra and Koehler's (2006) TPACK framework, these pedagogical gains occur precisely when digital tools are aligned with subject content and active instructional strategies rather than used merely as decorative novelties.

Furthermore, the statistically significant predictive relationship established in the hypothesis test confirms that variation in classroom technology integration substantially accounts for differences in student learning outcomes across AMAC secondary schools. While nearly half of the variance in student outcomes is explained by technology integration, the remaining unexplained variance underscores that digital tools operate within a broader educational ecosystem shaped by teacher pedagogical mastery, school leadership, socioeconomic equity, and classroom environment. This reinforces Chukwuemeka and Aregbesola's (2025) conclusion in the FCT that teacher subject-specific technological proficiency is indispensable for translating hardware investments into measurable academic gains, as well as Yusuf et al.'s (2025) local evidence demonstrating strong positive associations between digital instruction and student achievement in AMAC.

Conclusion

This study investigated the integration of technology in education as a catalyst for enhanced learning outcomes in secondary schools in Abuja Municipal Area Council (AMAC), Federal Capital Territory, Nigeria. Based on the empirical evidence generated, it is concluded that digital technologies—particularly computers and multimedia presentation tools—have achieved substantial adoption in AMAC secondary schools, though interactive online platforms remain comparatively underutilised. More importantly, effective integration of technology into classroom instruction serves as a potent, statistically significant catalyst for improving students' conceptual understanding, motivation, classroom participation, knowledge retention, independent learning, and overall academic achievement.

Nevertheless, the long-term sustainability and pedagogical depth of these benefits depend on resolving persistent infrastructural and human-capacity constraints. Without reliable electricity, affordable broadband connectivity, equitable resource allocation between public and private schools, and continuous teacher professional development grounded in pedagogical-technological competence, technology integration risks remaining uneven and hardware-centric. Consequently, transforming digital tools into an enduring driver of educational excellence in AMAC requires a holistic approach that pairs infrastructural investment with structured teacher training, technical maintenance, and institutional policy support.

Recommendations

Based on the findings and conclusion of this study, the following actionable recommendations are proposed:

1. **Expand Equitable Digital Infrastructure:** The Federal Capital Territory Administration (FCTA) and the FCT Secondary Education Board should increase targeted capital investment in digital infrastructure across AMAC secondary schools, prioritising under-resourced public schools to bridge the digital divide between public and private institutions.
2. **Provide Reliable Alternative Power Solutions:** Because erratic power supply undermines consistent classroom technology use, school authorities and government agencies should equip secondary schools with solar power systems and dedicated backup inverters to guarantee uninterrupted operation of computers, projectors, and internet facilities.
3. **Improve Broadband Connectivity and Platform Adoption:** To address the comparatively lower utilisation of online educational platforms and digital learning applications, schools should partner with telecommunications providers and education authorities to secure subsidised, high-speed institutional internet connectivity and curated digital learning management systems.
4. **Strengthen Teacher TPACK Professional Development:** School administrators and the FCT Education Resource Centre should institute continuous, subject-specific training programmes focused on Technological Pedagogical Content Knowledge (TPACK), equipping teachers not merely with basic computer literacy but with practical strategies for integrating digital tools into curriculum delivery.
5. **Develop School-Level Technology Integration and Maintenance Plans:** Each secondary school in AMAC should formulate an institutional ICT integration policy specifying curricular targets, technical maintenance schedules, equipment security, and periodic monitoring so that acquired facilities do not fall into disrepair or underutilisation.
6. **Promote Guided Student Digital Literacy and Community Partnerships:** Schools should incorporate structured digital literacy and academic research guidance for students while partnering with Parents-Teachers Associations (PTAs) and community stakeholders to establish shared school-based digital resource centres for students lacking personal devices at home.

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