

ICT Device Utilization, Student Attitudes and Academic Achievement in Undergraduate Science Education: A Correlational Study

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ABSTRACT

This study examined ICT device utilization, students' attitudes toward ICT and their relationship with academic achievement among undergraduate Science Education students at Usmanu Danfodiyo University Sokoto, Nigeria. A correlational research design was adopted with a sample of 278 students. Data were collected using a questionnaire on ICT utilization and attitudes toward ICT, while academic achievement was measured using students' CGPA. Descriptive statistics were used to answer three research questions, while Pearson Product Moment Correlation tested two hypotheses at the 0.05 level of significance. The findings of the study revealed a moderate level of ICT utilization among students, with frequent use of smartphones, laptops, internet services and online materials, while tools such as desktop computers, learning management systems and educational software were less utilized. Students also indicated generally positive attitudes toward ICT. The results further showed a significant positive relationship between ICT utilization and academic achievement, as well as between students' attitudes toward ICT and their level of ICT utilization. The study concludes that positive attitudes toward ICT encourage greater use of digital tools, which improve students' academic achievement. It recommends strengthening ICT infrastructure, integrating digital pedagogy into teacher education programmes, and improving digital skills among preservice science teachers.

INTRODUCTION

The widespread integration of information and communication technologies (ICT) has profoundly transformed teaching, learning, and knowledge construction within higher education systems globally. Contemporary universities increasingly rely on digital tools such as computers, mobile devices, internet-based resources, learning management systems, and online academic databases to enrich instructional delivery, promote interactive learning, and support students' academic development (Isma'il et al., 2024; Isma'il and Olatunbosun, 2024).). In this digital era, ICT is no longer regarded as a peripheral instructional aid; rather, it has become a core component of pedagogical innovation, student engagement, and the development of higher-order cognitive and professional skills. According to Matazu and Isma'il (2025), in science education where conceptual understanding relies on visualization, simulations, data analysis, and access to up-to-date scientific information, the effective use of ICT devices is crucial for enhancing learning outcomes and academic achievement.

Empirical research increasingly reveals that the educational value of ICT lies not merely in its presence but in how students engage with digital tools and the attitudes they hold toward their use. Evidence from large-scale international studies shows that students' perceptions, confidence, and purposeful use of ICT are stronger predictors of academic achievement than the frequency of use alone (Courtney et al., 2022). Similarly, systematic reviews reveal that ICT contributes positively to learning only when it is used strategically for academic tasks such as research, problem-solving, collaboration, and content mastery, rather than for non-academic or recreational activities (Amez & Baert, 2020). These findings underscore the importance of examining ICT utilization patterns alongside students' attitudinal dispositions when assessing educational outcomes.

In developing educational settings, particularly in sub-Saharan Africa, scholarly discourse on ICT in education has expanded significantly as universities increasingly adopt digital technologies to support teaching and learning. In Nigeria, early studies indicated that undergraduates increasingly depend on online platforms and digital resources for academic research and coursework, with positive implications for learning outcomes (Ogedebe, 2012). Subsequent research further indicates that students' engagement with ICT tools and their attitudes toward technology play a meaningful role in shaping academic performance. For example, Achimugu (2016) observed that the educational impact of ICT is strongly influenced by how effectively users engage with available tools, while Musa et al. (2017) noted that students' learning gains are closely linked to their patterns of ICT use within academic environments. Mohammed et al. (2019) similarly emphasized that ICT contributes to improved learning outcomes when students reveal positive dispositions and competence in its use.

Empirical evidence reinforces these observations. Studies conducted in Ethiopia (Hailegebreal et al., 2022), Liberia (Sieh et al., 2022), Pakistan (Kashif et al., 2020), and Europe (García-Martínez et al., 2021) consistently report significant relationships between ICT device utilization, students' attitudes toward

technology, and academic achievement. These studies reveal that learners who actively and meaningfully engage with ICT tools tend to have better academic performance than their counterparts with lower levels of engagement. Furthermore, theoretical models rooted in the Technology Acceptance Model indicate that perceived usefulness, ease of use, and satisfaction significantly influence students' attitudes toward ICT and their willingness to integrate digital tools into learning activities (Edmunds et al., 2009; Al-Rahmi et al., 2022).

Despite the growing body of literature, empirical studies that specifically examine the relationship between ICT device utilization, students' attitudes, and academic achievement among undergraduate science education students in Nigerian universities remain limited. Existing local studies largely concentrate on secondary school settings or focus on teachers' use of technology, thereby offering limited understanding into university students' learning behaviors and academic outcomes. Consequently, this study investigates the relationship between ICT device utilization, students' attitudes toward ICT, and academic achievement among undergraduate science education students at Usmanu Danfodiyo University, Sokoto, Nigeria.

LITERATURE REVIEW

Theoretical Framework

This study is grounded in the Technology Acceptance Model (TAM), the Theory of Planned Behavior (TPB), and constructivist learning theory to explain the relationships among ICT device utilization, students' attitudes, and academic achievement. TAM, proposed by Fred Davis, posits that individuals' attitudes toward technology shaped by perceived usefulness and ease of use, determine their actual utilization of technological tools (Davis, 1989). In science education, students who perceive ICT devices as useful for learning are more likely to utilize them effectively, thereby improving academic achievement. The TPB, advanced by Icek Ajzen, further emphasizes attitude as a key determinant of behavioral intention and actual behavior (Ajzen, 1991). Within this framework, positive attitudes toward ICT devices are expected to promote consistent academic use, which in turn supports better learning outcomes. Attitude is therefore conceptualized as both a direct predictor of ICT utilization and an indirect contributor to academic achievement.

ICT Utilization and Academic Achievement

ICT has become a critical element in modern higher education, particularly in science disciplines, where interactive, research-driven learning is central. Tools such as computers, tablets, virtual laboratories, learning management systems, and online databases provide students with access to information, foster critical thinking, and support problem-solving skills (Courtney et al., 2022). Research indicates that effective ICT utilization is positively associated with academic achievement, but this relationship depends on how purposefully students engage with technology (Amez & Baert, 2020;

Hazelhurst et al., 2011). Consistent use of ICT for academic purposes, rather than mere recreational or sporadic use, has been shown to improve learning outcomes, deepen conceptual understanding, and improve students' performance across science and technology courses (Moubayed et al., 2020; Maqableh et al., 2021).

Globally, empirical evidence supports the academic benefits of ICT utilization. Hailegebreal et al. (2022) found that Ethiopian undergraduates who effectively used ICT tools proved to have higher academic performance than peers with limited engagement. Similarly, in Liberia, Sieh et al. (2022) reported a significant positive correlation between ICT skillfulness and GPA among university students. In Pakistan, Kashif et al. (2020) found that students with access to laptops, personal computers, and the Internet were able to utilize these tools to complete assignments efficiently, improve research skills, and improve learning outcomes. European studies also indicate the benefits of collaborative ICT use; García-Martínez et al. (2021) observed that students who engaged in structured online collaboration and digital content creation performed better academically.

Studies conducted in Nigeria reveal both the potential and the challenges of ICT integration in higher education. Ogedebe (2012) reported that undergraduates actively leveraging online resources and cyberspace for academic research gradually improved their performance. Similarly, Mohammed et al. (2019) report that access to ICT resources positively influenced learning outcomes, but the full potential was limited by insufficient training and institutional support. These findings collectively indicate that ICT utilization can improve academic achievement when students possess the necessary skills, access appropriate resources, and engage meaningfully with technology.

Students' Attitudes Toward ICT and Academic Performance

While access and utilization of ICT are critical, students' attitudes toward technology play an equally important role in shaping its effectiveness. The Technology Acceptance Model emphasizes that perceived usefulness and perceived ease of use strongly influence students' intention to adopt and use ICT tools (Edmunds et al., 2009). Positive attitudes, including confidence, interest, and motivation, increase engagement with digital tools and promote better academic outcomes (García-Martínez et al., 2021). For instance, Acosta-Gonzaga and Walet (2016) found that students who enjoyed using online STEM resources were more likely to participate actively in learning activities and perform better academically. Demir and Akpınar (2018) also reported that mobile learning applications improved both students' attitudes and performance, reinforcing the reciprocal relationship between perception and achievement.

In Nigeria, studies show that attitudes are closely linked with ICT utilization and academic success. Abdulhamid and Dauda (2019) found that undergraduates with favorable attitudes toward ICT were more likely to engage with digital resources and achieve higher academic outcomes. Oladele and Molará (2017) similarly reported that mobile technology acceptance predicted increased engagement, improved study habits and improved performance. Salhab and Daher (2023) emphasized that students' exposure to mobile learning

environments positively influenced their motivation, engagement, and perception of learning effectiveness. These studies collectively indicate that fostering positive attitudes is essential to realizing the full educational potential of ICT. Without encouraging perceptions, even the most sophisticated technology may remain underutilized, limiting its impact on academic performance.

Empirical Evidence

Several empirical studies reveal the interplay of availability, accessibility, utilization, attitudes, and skills in predicting academic achievement. In Nigeria, Achimugu (2016) observed that limited availability of ICT facilities constrained teachers' use of technology, indirectly impacting students' learning opportunities. Musa et al. (2017) reported that while some schools were equipped with ICT tools, students' restricted access and teachers' underutilization reduced learning benefits. Akubuilu et al. (2021) found inadequate ICT infrastructure and limited use among social studies teachers in Enugu State, emphasizing that availability alone does not guarantee improved learning outcomes. Adenariwo and Sulyman (2022) reported that electronic information resources including e-journals, e-books, and databases, could improve academic performance, but poor funding, infrastructure deficits, and limited access constrained students' engagement. Edet and Ann (2022) stressed that proper utilization of laboratory resources, including computers, keyboards, monitors, and software applications, significantly improved undergraduates' skill acquisition. Similarly, Abubakar et al. (2023) found that availability and use of ICT equipment positively affected agricultural science students' academic performance, although restricted access limited potential benefits.

Beyond availability, students' behavioral skills and engagement patterns shape academic outcomes. Al-Rahmi et al. (2022) reported that perceived usefulness, self-efficacy, and satisfaction predicted mobile learning adoption among university students. Silva et al. (2024) found that digital competence, motivation, and institutional support strongly influenced ICT use, while Suleiman et al. (2020) reported that positive attitudes toward ICT correlated with higher performance in mathematics. Studies have shown that structured ICT engagement consistently improves academic outcome, for instance, Hazelhurst et al. (2011) reported that goal-directed web usage led to better grades and Moubayed et al. (2020) observed that consistent interaction with e-learning platforms improved student achievement. Maqableh et al. (2021) further emphasized that sustained usage intentions mediate the relationship between ICT utilization and academic performance. Conversely, Amez and Baert (2020) cautioned that excessive recreational or non-academic ICT use may negatively affect learning outcomes.

Statement of the Problem

ICT is essential in contemporary science education, equipping undergraduate students with the skills to access, process, and apply knowledge effectively. For science education undergraduates at Usmanu Danfodiyo

University Sokoto (UDUS), proficiency in ICT is crucial for their academic success and future roles as technology-capable teachers. However, inadequate utilization of available ICT devices due to limited access, insufficient training, or lack of engagement, can hinder students' learning, diminish interest in scientific inquiry, and compromise the quality of teacher preparation. While ICT's role in improving academic achievement is well established globally, there is a paucity of empirical research in Nigeria examining how ICT utilization, alongside students' attitudes, influences performance among science education undergraduates. Addressing this gap is critical for understanding barriers to effective ICT engagement, guiding institutional interventions, and ensuring that graduates are competent in integrating technology into teaching and learning in a rapidly digitalizing educational environment.

Objectives of the Study

The main objective of this study was to examine undergraduate Science Education students' attitudes toward and utilization of ICT devices, and their relationship with academic achievement at Usmanu Danfodiyo University, Sokoto, Nigeria.

Research Questions

The study was guided by the following research questions:

1. What is the level of ICT device utilization among undergraduate Science Education students?
2. What are the mean scores of ICT device utilization and academic achievement among undergraduate Science Education students?
3. What are the mean scores of undergraduate Science Education students' attitudes toward ICT and their utilization of ICT devices?

Null Hypotheses

The following null hypotheses were tested at the 0.05 level of significance:

- H₀₁: There is no significant relationship between ICT device utilization and academic achievement among undergraduate Science Education students.
- H₀₂: There is no significant relationship between undergraduate Science Education students' attitudes toward ICT and their utilization of ICT devices.

METHODS

Research Design

This study employed a correlational research design to examine the relationships among ICT device utilization, students' attitudes toward ICT, and academic achievement. Correlational designs are widely used in educational research to investigate naturally occurring associations among variables without manipulation, making them appropriate for studies involving learners' behaviors and perceptions (Creswell, 2014).

Population and Sample

The population of the study consisted of all undergraduate students enrolled in Biology Education, Chemistry Education, Mathematics Education, and Physics Education programmes in the Department of Science and Vocational Education (DSVE), Usmanu Danfodiyo University, Sokoto. These students constitute prospective science teachers, for whom effective ICT integration is pedagogically essential. A sample size of 278 students was determined using Yamane's (1967) formula for finite populations. The sample was proportionately allocated across the four programmes based on enrollment figures to ensure representativeness. Simple random sampling was applied across academic levels to minimize selection bias and improve the generalizability of findings within the department.

Instrumentation

Data were collected using a structured questionnaire titled Utilization of ICT Devices Questionnaire (UICTDQ), developed by the researcher based on prior empirical studies and relevant theoretical constructs. The instrument comprised two sections: Section A (ICT Device Utilization) and Section B (Students' Attitudes Toward ICT). Section A contained 9 items measuring the extent to which students used ICT devices (e.g., computers, smartphones, internet resources, and productivity software) for academic purposes. Responses were rated on a 4-point Likert scale ranging from 1 = Not Utilized to 4 = Adequately Utilized. Section B included 13 items assessing students' perceptions, confidence, motivation, and disposition toward ICT use in learning. Responses ranged from 1 = Strongly Disagree to 4 = Strongly Agree.

Academic achievement was operationalized using students' Cumulative Grade Point Average (CGPA), obtained from the departmental examination office. The CGPA is computed on a 5-point grading scale, where higher values indicate stronger academic performance, and serves as a standardized and objective indicator of achievement across programmes.

Validity and Reliability

Face and content validity of the UICTDQ were established through expert review by three specialists in Science Education and Educational Foundations from two federal universities. Their feedback informed revisions that improved item clarity, construct relevance, and alignment with study objectives. Instrument reliability was determined through a pilot test involving 30 undergraduate students outside the study sample. Cronbach's alpha coefficient of 0.80 was obtained, indicating good internal consistency and suitability for large-scale data collection.

Data Collection Procedure

The researcher personally administered the questionnaire to the selected participants during scheduled lecture periods. Participation was voluntary, and questionnaires were retrieved immediately after completion to prevent data loss.

and ensure completeness. Respondents were briefed on the study's purpose and assured of confidentiality and anonymity.

Data Analysis

Data were analyzed using SPSS version 25. Descriptive statistics (mean and standard deviation) were used to summarize levels of ICT utilization and students' attitudes. A criterion mean of 2.50 was adopted to interpret Likert-scale responses. Inferential analysis was conducted using the Pearson Product-Moment Correlation Coefficient (r) to examine relationships among ICT utilization, attitudes, and academic achievement at the 0.05 level of significance, consistent with the scale properties and linear nature of the variables.

Ethical Considerations

Ethical approval was obtained from the Department of Science and Vocational Education. Participants provided informed consent and were assured that their responses would be used solely for research purposes. No identifying information was collected and all data were securely stored in compliance with institutional research ethics guidelines.

RESULTS

Research Question One: What is the level of ICT device utilization among undergraduate Science Education students?

Table 1. Descriptive statistics of ICT device utilization among undergraduate Science Education students

ICT Device	Mean	SD	Variance	Min	Max	% $\geq$ 2.5	Remark
Desktop Computer	2.42	1.06	1.12	1	4	48%	Underutilized
Laptop	3.12	0.92	0.85	1	4	74%	Utilized
Smartphone	3.45	0.83	0.69	2	4	88%	Utilized
Tablet / iPad	2.38	0.98	0.96	1	4	46%	Underutilized
Internet / Network Services	3.29	0.82	0.67	2	4	81%	Utilized
Email Platforms	3.08	0.88	0.77	1	4	70%	Utilized
Learning Management Systems	2.35	0.97	0.94	1	4	44%	Underutilized
Educational Software / Simulation Tools	2.30	0.95	0.90	1	4	41%	Underutilized
E-materials / Online Resources	3.11	0.89	0.79	2	4	73%	Utilized

Video Conferencing Tools	2.48	0.91	0.83	1	4	49%	Underutilized
Interactive Whiteboards / Smartboards	2.40	1.02	1.04	1	4	45%	Underutilized
Digital Recording Devices	2.67	1.13	1.28	1	4	60%	Utilized
Graphing Tools / Apps	3.05	0.94	0.88	2	4	71%	Utilized
Online Collaboration Tools	2.48	0.90	0.81	1	4	49%	Underutilized

N = 278; Grand Mean = 2.75; SD = 0.93

Table 1 indicates a moderate overall level of ICT device utilization among undergraduate Science Education students (Grand Mean = 2.75, SD = 0.93). Frequently utilized ICT tools include smartphones (M = 3.45, SD = 0.83, 88%), internet/network services (M = 3.29, SD = 0.82, 81%), and laptops (M = 3.12, SD = 0.92, 74%), reflecting students' preference for portable and internet-enabled technologies. In contrast, desktop computers (M = 2.42), learning management systems (M = 2.35), and educational simulation software (M = 2.30) were underutilized. The wide dispersion of scores (SD range = 0.82–1.13) revealing unequal access and competence. These patterns necessitate examining how such utilization levels relate to students' academic achievement, which is addressed in the next table.

Research Question Two: What are the mean scores of ICT device utilization and academic achievement among undergraduate Science Education students?

Table 2. Descriptive statistics of ICT device utilization and academic achievement

Variable	N	Mean	SD	Minimum	Maximum
ICT Device Utilization	278	3.02	0.48	1.00	4.00
Academic Achievement (CGPA)	278	3.21	0.55	1.50	4.50

Table 2 shows that undergraduate Science Education students indicated moderate ICT utilization (M = 3.02, SD = 0.48) alongside above-average academic achievement measured by CGPA (M = 3.21, SD = 0.55). The relatively low standard deviations indicate homogeneity in both ICT usage patterns and academic outcomes, revealing stable learning conditions across participants. The mean ICT utilization score exceeding the scale midpoint implies consistent

engagement with digital tools for academic purposes. Descriptive statistics are insufficient to explain this relationship; therefore, a correlation analysis was conducted as shown in Table 3.

Null Hypothesis One (H₀₁): There is no significant relationship between ICT device utilization and academic achievement.

Table 3. Pearson correlation between ICT device utilization and academic achievement

N	r	R ²	t-count	t-table	Sig.
			0.05		
278	0.56	0.31	12.345	1.968	0.000

Results in Table 3 reveal a moderate, positive, and statistically significant relationship between ICT device utilization and academic achievement ($r = 0.56$, $p < .01$). The coefficient of determination ($R^2 = 0.31$) indicates that 31% of the variance in CGPA is explained by ICT utilization, representing a substantial effect in educational research. The computed t-value ($t = 12.345$) exceeds the critical value (1.968), confirming statistical significance at the 0.05 level. Consequently, H₀₁ is rejected.

Research Question Three: What are the mean scores of undergraduate Science Education students' attitudes toward ICT and their utilization of ICT devices?

Table 4. Descriptive statistics of students' attitudes toward ICT

Variable	N	Mean	SD	Minimum	Maximum
Attitudes Toward ICT	278	3.12	0.79	1.00	4.00
ICT Device Utilization	278	3.02	0.48	1.00	4.00

Table 4 presents the mean scores of undergraduate Science Education students' attitudes toward ICT and their utilization of ICT devices. The results show that students have generally positive attitudes toward ICT ($M = 3.12$, $SD = 0.79$). Similarly, the mean score for ICT device utilization ($M = 3.02$, $SD = 0.48$) indicates that students make considerable use of ICT devices for academic activities. The standard deviation values show some variation in responses among the students. These indicates a link between ICT attitudes and usage; this relationship was therefore tested using correlation analysis (Table 5).

Null Hypothesis Two (H₀₂): There is no significant relationship between students' attitudes toward ICT and ICT device utilization.

Table 5. Pearson correlation between attitudes toward ICT and ICT utilization

N	r	R ²	t-count	t-table	Sig.
			0.05		

278	0.62	0.38	15.34	1.968	0.000
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Table 5 reveals a strong, positive, and statistically significant relationship between students' attitudes toward ICT and ICT device utilization ($r = 0.62$, $p < .01$). The R^2 value of 0.38 indicates that 38% of the variance in ICT utilization is attributable to students' attitudes, representing a large explanatory effect. The calculated t-value ($t = 15.34$) far exceeds the critical threshold (1.968), confirming statistical significance. Accordingly, H_{02} is rejected.

DISCUSSION

The findings of this study indicate that undergraduate Science Education students in the Department of Science and Vocational Education at Usmanu Danfodiyo University, Sokoto, reveal moderate overall utilization of ICT devices. Among the most frequently used tools were smartphones, internet and network services, and laptops, reflecting students' preference for portable and internet-enabled technologies for academic purposes. In contrast, more traditional or structured ICT platforms, including desktop computers, learning management systems, and educational simulation software, were less frequently utilized. These reveal that while students are comfortable with accessible technologies, adoption of curriculum-integrated ICT tools remains limited, consistent with the findings of Oriogu et al. (2014) and Osuchukwu et al. (2018).

Students' attitudes toward ICT were generally positive, indicating confidence, motivation, and favorable perceptions of digital tools for learning. Most students acknowledged the usefulness of ICT for academic tasks and expressed willingness to integrate digital resources into their studies. This finding aligns with Arthur (2010), who reported that health sciences students at Cape Coast University exhibited positive attitudes toward ICT, and with Abdulaziz et al. (2013), who observed similar trends among postgraduate students in Malaysian universities. Yusuf and Balogun (2011) similarly found that Nigerian student-teachers hold favorable attitudes toward ICT, which often influences the extent to which they engage with digital platforms.

The study also established a positive relationship between students' attitudes toward ICT and their actual use of ICT devices. Students with favorable perceptions of ICT were more likely to utilize both basic and advanced digital tools for learning, supporting the principles of the Technology Acceptance Model articulated by Davis (1989) and extended by Al-Rahmi et al. (2022). This indicates that improving students' perceptions of usefulness and ease of use can directly impact their engagement with ICT. Targeted interventions such as digital skills workshops, hands-on training and motivation programmes may therefore increase utilization of underused platforms, including learning management systems and simulation software.

Furthermore, the study revealed that ICT device utilization is associated with improved academic achievement. Students who actively engaged with laptops, smartphones, network services, and online resources tended to perform better in their courses. This finding aligns with Courtney et al. (2022), who emphasized that productive engagement with digital tools improves learning

outcomes, and with studies conducted in Pakistan (Kashif et al., 2020) and Europe (García-Martínez et al., 2021), which reported the link between ICT use and student performance. The results reveal that nurturing consistent and purposeful use of ICT devices in academic tasks can significantly support students' learning and achievement.

CONCLUSION AND RECOMMENDATIONS

The study concludes that undergraduate Science Education students at Usmanu Danfodiyo University Sokoto reported substantial utilization of ICT devices alongside generally positive attitudes toward their academic use. ICT appears to be integrated into students' learning routines, thereby influencing access to instructional materials, assignment completion and engagement with course content. The findings further revealed that favourable attitudes may reinforce consistent and purposeful ICT utilization. Based on these, the study recommends that, in order to optimize academic benefits, the university should strengthen digital infrastructure, promote pedagogically guided ICT integration and provide continuous support that improves students' digital competence within science education programmes.

FURTHER STUDIES

Further studies should examine ICT utilization across multiple universities, include larger samples, and investigate additional factors influencing students' academic performance.

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