RESEARCH ARTICLE

# The influence of technology-integrated curriculum resources on student engagement and academic achievement in higher education

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**Abstract:** This descriptive survey investigates the influence of technology-integrated curriculum resources on student engagement and academic achievement in tertiary institutions in Sokoto State, Nigeria. The study addresses four research questions focusing on educators' understanding of technology integration, its impact on student engagement and academic achievement, and the role of socioeconomic, cultural, and infrastructural factors. Data were collected from 318 participants using a structured questionnaire and analysed descriptively. Findings reveal a positive perception of technology integration among educators, with high mean scores indicating strong understanding and favourable attitudes towards technology-integrated curriculum resources. However, variability exists in specific beliefs and practices, highlighting the need for targeted professional development and policy support. Moreover, while students perceive technology integration positively for aspects like assignment completion and curiosity, there are lower ratings for making learning exciting and connecting to subjects. The study underscores the significance of addressing socioeconomic, cultural, and infrastructural factors in promoting effective technology integration and recommends investments in infrastructure, comprehensive professional development, clear policy frameworks, collaborative partnerships, and ongoing research to enhance technology-enhanced education in Sokoto State.

**Keywords:** technology integration, curriculum resource integration, students engagement, academic achievement

## 1  Introduction

The education landscape has undergone profound changes in recent years, driven by technological advancements, shifts in pedagogical philosophies, and evolving student needs (Papadakis et al., 2023). Globally, there has been a decisive movement from traditional, teacher-centred models of instruction to approaches that prioritise active learning, critical thinking, and student engagement (Sliwka et al., 2024). This shift is vital for cultivating skills necessary for success in a dynamic, knowledge-based economy, where innovation and adaptability are increasingly valued (Tülübaş et al., 2023). It underscores the pressing need for educational models that embrace flexibility and adapt to learners' diverse experiences and cognitive styles (Lavidas et al., 2022).

A critical response to this demand is integrating technology within curriculum resources, which has gained considerable attention to create more inclusive and engaging learning environments. Technology-integrated curriculum resources involve various instructional materials, including digital tools, multimedia content, and real-world applications, strategically embedded within teaching plans to enhance instructional delivery and deepen students' understanding of complex concepts (Thelma et al., 2024). Incorporating such resources can bridge the gap between theoretical knowledge and practical application, making learning more relevant and promoting higher-order thinking skills. These resources are vital in catering to diverse learning styles, enabling instructors to present content in multiple visual, auditory, and kinesthetic formats, thus enhancing engagement and supporting students with varied cognitive preferences (Karakose et al., 2022; 2023). However, implementing technology-integrated curriculum resources faces significant challenges, particularly in resource-constrained settings like Nigeria. Higher education institutions in Nigeria often need more infrastructure, such as inadequate access to digital tools, limited internet connectivity, and outdated technological facilities, which

restrict the effectiveness of technology integration (Ogunode & Musa, 2020). Additionally, the rigid structure of traditional curricula and limited opportunities for teacher training further hinder the adoption of innovative practices. As Ajonbadi et al. (2023) emphasise, these obstacles are compounded by socioeconomic disparities affecting institutions and students, limiting access to consistent and equitable educational experiences across regions.

Theoretical perspectives also support the need for a paradigm shift in Nigerian tertiary education toward technology-integrated instruction. Constructivist learning theories, which emphasise the importance of active engagement and experiential learning, argue that students learn more effectively when they actively construct knowledge through exploration and interaction (Piaget, 1972; Vygotsky, 1978). Technology integration within curricula aligns with these principles, allowing students to interact with content interactively and build connections between theory and practice. Moreover, the self-determination theory suggests that fostering autonomy and competence through digital tools can increase intrinsic motivation among students, thus supporting engagement and retention (Hsu et al., 2019).

This study investigates these dynamics by focusing on the impact of technology-integrated curriculum resources on student engagement and academic achievement within tertiary institutions in Sokoto State, Nigeria. The research addresses the following core questions: To what extent do these resources influence student engagement? How do they contribute to or hinder academic achievement? In exploring these questions, this study aims to uncover actionable insights to inform educational policy and practice, explicitly highlighting the conditions necessary for successful technology integration in curriculum resources. The research seeks to guide efforts toward a more inclusive, engaging, and effective educational framework by identifying the benefits and barriers in this context.

## 1.1    Statement of the problem

This investigation is motivated by the global shift towards student-centred teaching methodologies, emphasising active learning and incorporating diverse educational resources. While curriculum resource integration is recognised as a potentially impactful strategy for enhancing teaching and learning outcomes, its practical implementation faces challenges, particularly within the higher education landscape of Nigeria (Ahmadi & Lukman, 2015). This study investigates how the deliberate inclusion of various educational materials, such as digital technologies and multimedia resources, in instructional plans influences student engagement and academic achievement in tertiary institutions in Sokoto State, Nigeria, where socioeconomic, cultural, and infrastructural factors may pose additional obstacles.

The tertiary institutions in Sokoto State present a unique educational setting characterised by socioeconomic challenges, cultural diversity, and geographic disparities (Nlewem, 2018). These factors, combined with broader issues such as limited access to technology, inadequate infrastructure, and curriculum rigidity, contribute to the complexity of effectively implementing technology-integrated curriculum resource strategies. Despite efforts to reform educational practices and improve learning outcomes in Nigeria, there still needs to be a solution to understanding the specific dynamics of technology-integrated curriculum resources integration within higher education institutions in Sokoto State. Thus, this study seeks to fill this gap by examining the perceptions, practices, and outcomes associated with technology-integrated curriculum resources integration in instructional plans at tertiary institutions in Sokoto State.

## 1.2    Research questions

The following research questions are formulated to guide the conduct of this study:

(1) What is the level of understanding of technology-integrated curriculum resources among lecturers in tertiary institutions in Sokoto State, Nigeria?

(2) How does the inclusion of technology-integrated curriculum resources influence student engagement in tertiary institutions in Sokoto State, Nigeria?

(3) To what extent does integrating technology-enhanced curriculum resources affect students' academic achievement in tertiary institutions in Sokoto State, Nigeria?

(4) How do socioeconomic, cultural, and infrastructural factors affect the success of integrating technology-enhanced curriculum resources in tertiary institutions in Sokoto State, Nigeria?

## 1.3    Literature review

This study's framework is grounded in critical constructs related to technology integration, curriculum resource integration, student engagement, and academic achievement within the

framework of tertiary institutions in Sokoto State, Nigeria. This section defines the key variables, drawing on relevant literature and scholarly perspectives.

Technology integration in education involves deliberately incorporating various digital tools, resources, and technologies into instructional practices to enhance teaching and learning experiences (Marcelo & Yot-Domínguez, 2019). This approach is guided by pedagogical principles that promote student-centred learning, active engagement, critical thinking, collaboration, and creativity (Capone, 2022). Rooted in constructivist and social-cognitive theories, technology integration emphasises the active role of learners in constructing their understanding through interaction with their environment and peers (Schmidt, 2017). Technology integration is broad, encompassing digital resources such as computers, tablets, interactive whiteboards, educational software, multimedia presentations, online learning platforms, and educational apps (Haleem et al., 2022). As a dynamic and evolving instructional approach, it seeks to utilise digital tools to create rich and meaningful student learning experiences (Dahal et al., 2022).

Curriculum resource integration involves the deliberate and systematic incorporation of various educational materials, tools, and technologies into the instructional design and delivery process to enhance teaching and learning experiences (Livingstone, 2019). This approach includes carefully selecting, adapting, and utilising resources such as textbooks, digital media, online platforms, manipulatives, and real-world artefacts to support learning objectives and promote student engagement and achievement (Marshall, 2016). Effective curriculum resource integration requires educators to be proficient in selecting, adapting, and incorporating diverse resources to create meaningful learning experiences. This integration aligns with broader educational goals of fostering 21st-century skills such as critical thinking, creativity, collaboration, and communication (Care et al., 2018).

Student engagement refers to the degree of involvement, interest, and interaction that students demonstrate in their learning activities, both inside and outside the classroom (Kahu & Nelson, 2018). It encompasses various cognitive, emotional, and behavioural dimensions that reflect how students are motivated to learn, participate actively in learning tasks, and persist in facing challenges (Sinatra et al., 2015). Student engagement constitutes a pivotal aspect of the learning process, encompassing cognitive, emotional, and behavioural dimensions of student involvement in educational activities (Alrashidi et al., 2016). It is characterised by positive affective experiences, such as interest, enjoyment, and enthusiasm for learning, as well as cognitive processes, including critical thinking, deep information processing, and meaningful knowledge integration (Tsoukala, 2021).

Academic achievement refers to attaining learning outcomes and demonstrating knowledge, skills, and competencies acquired through educational experiences within a formal academic setting (Coleman & McLean, 2015). It encompasses various aspects of student performance, including grades, test scores, class rank, mastery of subject matter content, and higher-order cognitive processes such as critical thinking, problem-solving, and application of knowledge (Darling-Hammond, 2017). It reflects the culmination of educational experiences and how students have attained the intended learning outcomes within a given educational context (Vlachoudi et al., 2023).

Curriculum resource integration significantly impacts student engagement by offering interactive, diverse, and relevant learning experiences (Alpochoritis et al., 2022). When educators incorporate various educational materials, digital technologies, and multimedia resources into their instructional plans, they create dynamic environments that cater to students' diverse learning needs and preferences (Haleem et al., 2022). This diversity in instructional resources promotes active learning, encouraging students to participate fully. For instance, interactive simulations, multimedia presentations, and online platforms foster curiosity and exploration, allowing students to engage deeply with the content and better understand concepts (Javed, 2023).

In Nigeria, curriculum resource integration has become increasingly evident, especially in addressing challenges like limited access to traditional educational materials and the growing role of digital technologies (Ali, 2020). The government has recognised this need, implementing the National Policy on Education and the Universal Basic Education Commission (UBEC) ICT School Connectivity Project (Olojo, 2021). However, the effective implementation of curriculum resource integration in Nigerian educational institutions still needs to improve, including inadequate infrastructure, low digital literacy, and limited resource access (Adamu, 2023). These challenges are further exacerbated by socioeconomic factors, such as disparities in technology and internet access, which widen the digital divide and hinder the equitable adoption of curriculum resource integration strategies (Adeyemi & Oni, 2021).

Beyond the broader educational context, curriculum resource integration enhances student engagement by aligning curriculum content with students' interests and experiences (Junarti et al., 2023). Educators who incorporate culturally relevant materials into their instructional plans create learning experiences that resonate with students' backgrounds, fostering a sense of connection and ownership in their academic work (Gay, 2018). Given the increasing familiarity of students with digital technologies, using these tools facilitates interactive and collaborative learning, further promoting engagement and peer interaction (Qureshi et al., 2023). Platforms like online discussion forums, virtual simulations, and collaborative editing tools allow students to collaborate with peers, share ideas, and co-create knowledge, strengthening their sense of belonging and engagement in learning.

Curriculum resource integration also plays a crucial role in enhancing academic achievement by providing students with diverse learning materials, digital technologies, and multimedia resources that support their learning goals (Pepin et al., 2017). By incorporating a variety of instructional resources, educators can create enriching learning experiences that accommodate students' learning styles, preferences, and needs, ultimately leading to improved academic performance. This approach expands students' access to educational materials beyond traditional textbooks, offering multiple pathways for knowledge acquisition (Kassing & Jay, 2020). Through digital technologies, multimedia presentations, and online platforms, students can engage with interactive simulations, virtual laboratories, and authentic, real-world examples, deepening their understanding of complex concepts and promoting more profound learning (Hodges et al., 2018; Papadakis, 2023).

Additionally, curriculum resource integration supports personalised and differentiated instruction, enabling educators to tailor learning experiences to meet students' diverse needs and abilities (Ojong, 2023). By incorporating adaptive learning technologies, educational apps, and multimedia resources, educators can provide targeted support to students who need additional assistance, promoting equitable access to learning opportunities and improving academic outcomes (Darling-Hammond & Cook-Harvey, 2018).

## 1.4   Theoretical framework

This study explores the impact of technology-integrated curriculum resources on student engagement and academic achievement in tertiary institutions in Sokoto State, Nigeria, using Social Cognitive Theory (SCT) as its foundation. Proposed by Albert Bandura, SCT emphasises the reciprocal interaction between personal factors, environmental influences, and behaviour in shaping human learning and development (Bandura, 1986). According to SCT, individuals learn through observation, imitation, and modelling, with their behaviours influenced by cognitive processes such as attention, memory, and motivation. In this context, SCT provides a comprehensive framework for understanding how technology-integrated curriculum resources influence student engagement and academic outcomes, emphasising the crucial role of environmental factors, such as instructional practices and available resources.

SCT offers a valuable perspective for examining the level of understanding of technology-integrated curriculum resources among lecturers in Sokoto State's tertiary institutions. The theory suggests that educators' perceptions of their self-efficacy in using these resources significantly shape their instructional practices (Bandura, 1986). Lecturers effectively utilising technology-enhanced materials are more likely to integrate them into their curriculum. By exploring their understanding and self-efficacy beliefs, we can gain insights into their readiness to incorporate these resources and their perceived role in enhancing student engagement and learning.

When considering the impact of technology-integrated curriculum resources on student engagement, SCT highlights the importance of observation, imitation, and modelling in the learning process (Bandura, 1986). Educators who actively use these resources in the classroom provide students with opportunities to observe and engage with dynamic, interactive content, enhancing their learning experience. SCT suggests that educators' interactions with these resources and ability to model effective use can significantly influence students' motivation and engagement. Understanding how educators perceive their capabilities in using these tools can help clarify the mechanisms through which technology integration impacts student engagement.

SCT highlights the significance of self-efficacy beliefs in motivating behaviour and guiding learning, which is crucial when assessing the effect of technology-enhanced curriculum resources on academic achievement (Bandura, 1986). Educators with strong self-efficacy in using technology are more inclined to integrate these tools into their teaching, creating enriched learning environments that foster academic success. SCT indicates that the effectiveness of

technology integration in improving academic outcomes hinges on educators' confidence in their ability to utilise these resources to achieve instructional goals. Therefore, understanding how self-efficacy influences technology use offers a good understanding of the impact of these resources on students' academic performance.

SCT also underscores the significance of contextual factors, such as socioeconomic status and cultural background, in shaping learning experiences and outcomes (Bandura, 1986). In exploring how socioeconomic, cultural, and infrastructural factors affect the success of integrating technology-enhanced curriculum resources, SCT suggests examining the interaction between these contextual elements, personal characteristics, and environmental influences. This theory provides a lens for understanding how disparities in access to technology, cultural perceptions of education, and infrastructure challenges can influence the effectiveness of technology integration in fostering student engagement and academic achievement in Sokoto State's tertiary institutions. Building on these contextual insights, adopting technology-integrated curriculum resources in education reveals a transformative approach that aligns with SCT principles, enhancing learning by actively engaging students through observation and interaction.

## 1.5　Technology-integrated curriculum resources in education

Technology-integrated curriculum resources offer a transformative approach to instruction, aligning well with Social Cognitive Theory (SCT) principles. SCT posits that learning occurs through observation, imitation, and modelling within social and environmental contexts (Bandura, 1986). Educators allow students to actively observe and engage with content by integrating digital tools like virtual simulations, multimedia presentations, and interactive assessments. Such resources enable learners to build on prior knowledge, enhance their understanding, and apply concepts in varied, real-world contexts (Antonio & Castro, 2023). This active engagement aligns with SCT's emphasis on observational learning, as students can witness and replicate successful problem-solving and critical-thinking approaches through interactive technology.

Moreover, SCT's concept of reciprocal determinism highlights how behaviour, cognition, and environment influence learning (Bandura, 1986). Technology-integrated curriculum resources create an enriched learning environment where students are encouraged to interact with content and peers, reinforcing cognitive and behavioural development. Digital resources such as collaborative platforms and educational games facilitate social interactions, allowing students to work collectively while reinforcing academic concepts (Adipat et al., 2021). These interactions support SCT's premise that cognitive and social skills develop through shared experiences, which are vital for internalising knowledge and fostering motivation for continued. As a result, technology-integrated resources help students apply content knowledge within a supportive, interactive environment, promoting holistic learning outcomes.

Furthermore, SCT's focus on self-efficacy highlights another critical dimension of technology integration, as students build confidence and motivation when they succeed in navigating digital tools and achieving learning goals. SCT argues that students' confidence in their abilities can significantly influence their learning engagement and persistence (Bandura, 1997). As students successfully navigate digital tools and achieve learning outcomes, their self-efficacy grows, enhancing their willingness to take on new challenges. Educators who model effective technology use further support this self-efficacy development, as students are inspired by their instructors' proficiency and positive attitudes toward technology (Akram et al., 2022). Thus, technology-integrated curriculum resources are vital in Promoting self-efficacy and a resilient learning disposition, leading to more engaged and independent learners. This heightened self-efficacy translates into more profound engagement as students experience technology as a supportive tool for learning and skill mastery.

## 1.6　Influence of technology-integrated curriculum resources on student engagement

Integrating technology into curriculum resources profoundly impacts student engagement by providing dynamic and interactive learning experiences. SCT highlights that students learn actively through observation, imitation, and modelling within their environment (Bandura, 1986). Technology-integrated resources, such as digital simulations, multimedia presentations, and online discussion forums, align with SCT's principles, enabling students to interact with and internalise information more effectively. These digital tools encourage active participation and cognitive engagement as students navigate complex concepts, ask questions, and receive immediate feedback (Schwarts et al., 2024). Consequently, integrating technology into learning fosters deeper engagement by appealing to students' diverse learning styles and enhancing their

motivation to learn (Mouza et al., 2020).

Furthermore, technology-integrated curriculum resources promote a collaborative environment crucial to engagement. SCT emphasises the role of social interactions in learning, suggesting that students are more likely to be engaged when observing and interacting with peers and educators (Bandura, 1986). Digital platforms, such as collaborative learning apps and virtual classrooms, allow students to work on joint projects, discuss ideas, and support each other's learning (Liu & Chen, 2022). This collaborative learning process aligns with SCT by allowing students to model each other's approaches and attitudes toward learning. As students engage in these technology-mediated collaborations, they develop critical social and cognitive skills, ultimately enhancing their engagement and promoting a sense of belonging within the learning community (Zamecnik et al., 2022).

Interactive digital resources are vital for capturing and sustaining student attention, a critical engagement component. SCT suggests that engagement relies on attention, motivation, and memory processes, enhanced when learning activities are stimulating and meaningful (Bandura, 1986). Technology-integrated resources, such as educational games and simulations, offer immediate, real-time feedback and allow students to test their understanding in an engaging, risk-free environment (Timotheou et al., 2023). These interactive features improve students' focus and immersion in learning, helping them retain and apply information to real-life scenarios. Such active, immersive experiences increase attention and strengthen students' motivation to persist in challenging tasks (Huang et al., 2021).

SCT highlights self-efficacy as a critical factor influencing students' engagement with technology-integrated curriculum resources. When students experience success in navigating and utilising digital tools, their confidence and willingness to engage in similar learning tasks increase (Bandura, 1986). This shows that students who perceive themselves as competent in using technology feel more empowered to participate actively in digital learning environments, which enhances their engagement. Moreover, educators' effective modelling of technology use, as suggested by SCT, can reinforce students' positive attitudes toward technology and inspire them to explore digital resources more fully (Chiu, 2022). Building students' self-efficacy through well-designed, supportive, technology-integrated curriculum resources contributes significantly to sustained engagement and academic growth.

## 1.7 Technology-integrated curriculum resources on academic achievement

Integrating technology into curriculum resources enhances academic achievement by providing students with interactive and adaptive learning experiences that support SCT's emphasis on environmental influence in learning (Bandura, 1986). Technology-enriched environments, such as digital simulations, virtual labs, and multimedia presentations, allow students to engage with content actively, facilitating a more profound understanding and retention of complex concepts (Kurent & Avsec, 2024). Technology-integrated resources help bridge theoretical knowledge and practical application, which are critical to long-term academic success by enabling students to practice and apply their knowledge in real-world scenarios. This aligns with SCT's idea that learning is most effective when students can observe and practice within supportive, enriched environments.

SCT's construct of self-efficacy is also critical to understanding how technology integration affects academic achievement. Self-efficacy, or confidence in one's abilities, significantly impacts learning outcomes, as students with high self-efficacy are more likely to persist in challenging tasks and achieve their academic goals (Bandura, 1997). Technology-integrated curriculum resources, such as gamified assessments and progress-tracking tools, offer immediate feedback to strengthen students' confidence in their abilities (Matos et al., 2019). This positive reinforcement promotes motivation and perseverance, essential attributes for academic success. When students see clear evidence of their progress, they build resilience, enhancing their capacity to achieve desired learning outcomes.

Technology-integrated resources support SCT's principle of reciprocal determinism, whereby behaviour, cognitive processes, and environmental factors continuously interact to influence learning (Bandura, 1986). Through tools like collaborative platforms and adaptive learning software, students are encouraged to think critically, solve problems, and collaborate critical skills, contributing to academic achievement. These resources enable students to interact with content dynamically, promoting an active role in their learning process. Technology-integrated curriculum resources cultivate an academic foundation that benefits students' overall

achievement by creating a learning environment that nurtures critical thinking and supports individual learning paths (Matos et al., 2019).

## 1.8    Barriers to Successful Technology-Integrated Curriculum in Education

Socioeconomic status plays a significant role in shaping students' and educators' access to technology, thus impacting technology integration success. According to SCT, the environment strongly influences behaviour and learning outcomes (Bandura, 1986). In low-income communities, limited access to technology can hinder effective integration and create disparities in educational quality (Tahmasebi, 2023). When students need access to essential technological resources outside of school, their ability to engage and succeed in technology-enhanced curricula may be compromised. This digital divide affects academic achievement and contributes to self-efficacy challenges. SCT emphasises that confidence in one's ability is often developed through consistent exposure and practice in enriched environments (Fathi et al., 2024).

Cultural factors, including beliefs about technology's role in education, significantly influence technology adoption among students and teachers. SCT highlights observational learning as central to adopting new behaviours, where individuals look to role models and societal norms for cues (Bandura, 1997). Educators and parents may not prioritise or support technology integration in communities with low technological acceptance, impacting students' perceptions and engagement. According to Young and Asino (2020), cultural norms that discourage technology use can inhibit teachers' and students' belief in its educational value, ultimately affecting their motivation and willingness to integrate it into learning. Understanding cultural dynamics is vital for successful technology integration, as it enables the design of initiatives that align with the values and expectations of the community.

Infrastructural limitations, such as unreliable internet connectivity and inadequate technological support, also present significant barriers to technology integration. SCT emphasises the role of external factors in shaping learning and behaviour, meaning that a lack of infrastructural support can limit students' ability to engage with technology (Bandura, 1986). Schools without sufficient hardware, software, and connectivity face challenges in delivering a consistent technology-integrated curriculum, reducing both the effectiveness and sustainability of technology use in classrooms (Bećirović, 2023). This infrastructure gap is particularly critical in rural and underserved areas, where the lack of resources can lead to sporadic or limited access, undermining the establishment of positive learning habits and self-efficacy among students and teachers. Moreover, SCT's construct of reciprocal determinism highlights the interdependency of individual motivation, behaviour, and environment in successful technology adoption (Bandura, 1986). When socioeconomic, cultural, and infrastructural barriers are present, they interact with students' motivation and learning behaviours, creating a cycle that impedes technology integration. For instance, students in under-resourced environments may struggle to form positive attitudes toward technology, affecting their engagement and achievement (Timotheou et al., 2023). Addressing these factors requires systemic interventions, such as government investment in infrastructure, community engagement to shift cultural perceptions, and policies that support equitable access to technology, fostering an environment where SCT's self-efficacy, observational learning, and reciprocal influence can drive successful technology adoption.

The use of technology in education is relatively new in Nigeria and is still in its fairly early stage. Despite this shortcoming, some initiatives and research studies have been conducted in that area. In the study of Ojukwu et al. (2021), the COVID-19 pandemic has accelerated the adoption of educational technologies in tertiary institutions, emphasising the potential for improved digital education. However, the study's focus on Imo State may limit the generalizability of its findings to other regions, such as Sokoto State in Nigeria. Further research is needed to explore the specific impact of technology-integrated curriculum resources on student engagement and academic achievement in different Nigerian contexts.

In another study, professional development programs by Kafyulilo et al. (2015), focusing on integrating technology into teaching, can enhance teachers' knowledge and skills in utilising technology in subjects like science and mathematics. This finding suggests that structured training can positively impact technology adoption in education. However, the study needs to directly address the impact on student engagement and academic achievement, which is a limitation when considering its relevance to the investigation in Sokoto State, Nigeria. Further research is needed to explore the direct effects of technology integration on student outcomes in the Nigerian context.

According to (Oloyede et al., 2018), the Nigerian education system, particularly in engineering education, needs help adopting modern teaching methods despite the advancements in information and telecommunication technologies. The study highlights the need to shift towards a modified teaching-learning approach guided by real-world problems to enhance engineering education in Nigeria. However, the limitations of this study lie in the need for a more specific focus on technology-integrated curriculum resources and their impact on student engagement and academic achievement, which is the primary focus of the investigation in Sokoto State, Nigeria.

Kriek and Coetzee's (2016) study focused on developing a technology-integrated intervention for first-year physics students to enhance 21st-century learning. The research aimed to assess the effectiveness of this intervention when delivered by different lecturers. This study provides insights into the potential benefits of technology integration in higher education. Still, its limitations may include a narrow focus on a specific subject and year level, potentially limiting generalizability to broader educational contexts, such as those in Nigeria.

The study of Isiyaku et al. (2018) focused on the perceived usefulness of ICTs in Business Education classrooms in Nigerian tertiary institutions. While the research delved into factors influencing teachers' perceptions, it did not directly address the impact of technology-integrated curriculum resources on student engagement and academic achievement. This limitation highlights the need for further studies explicitly examining the effects of technology integration on student outcomes in the Nigerian context.

Owan et al.'s (2022) study focused on curriculum reengineering, web-based technology acquisition, and job creation among Nigerian tertiary institution graduates. While this research sheds light on graduates' perspectives, it does not directly address the impact of technology-integrated curriculum resources on student engagement and academic achievement, which is the focus of the current investigation in Sokoto State, Nigeria.

## 2  Methodology

The study used a descriptive survey research design because it is suitable for gathering data from a large population through questionnaires. It employed a quantitative approach to understand the nature of the problem better, enabling the researchers to understand the impact of technology-integrated curriculum resources on student engagement and academic achievement (Petousi & Sifaki, 2020).

The study population comprises all lecturers in public tertiary institutions in Sokoto State, with six institutions: 3 universities, two colleges of education, and one polytechnic. The study employs a multi-stage sampling approach to ensure a representative sample from the public tertiary institutions in the State. In the first stage, stratified random sampling was used to divide the population into three strata: universities (3), colleges of education (2), and polytechnic (1). Each stratum institution was randomly selected: university one, college of education two, and polytechnic 1. In the second stage, within each selected institution, simple random sampling was used to select three faculties from the university, three schools from the College of Education, and three colleges from the polytechnic. With a total population of 486 across these units, research advisors (2006) recommended a sample size of 217 lecturers. However, the researchers increased the sample size to 318 to ensure comprehensive data collection. In the final stage, simple random sampling was used to select 318 lecturers from the combined list of those in the chosen faculties, schools, and colleges. This approach facilitates a thorough investigation into the impact of technology-integrated curriculum resources on student engagement and academic achievement in tertiary institutions.

The instrument for data collection in this study is a questionnaire titled Lecturers' Technology Adoption Survey (LTAS)., a self-constructed questionnaire designed to elicit lecturers' responses on the impact of technology-integrated curriculum resources on student engagement and academic achievement. The LTAS is structured as a four-point Likert Scale questionnaire, consisting of five sections: "A" to "E". Section "A" collects personal data, while sections "B" to "E" seek out respondents' opinions or the statements that were used to answer the research questions. The Likert Scale ranges from "Strongly Disagree" (SD) to "Strongly Agree" (SA). This instrument ensures comprehensive data collection to address the research questions, with respondents guided to provide their opinions on each statement.

To validate the research instrument, it must comprehensively cover all the contents to be measured, and the instrument's items should accurately reflect the problem under study. The LTAS instruments used in this study were subjected to validation by three measurement experts

from the Faculty of Education, as well as other departments at the University of Ilorin, to critically examine the instruments to ensure that all contents are measured and the items of the instrument reflect the problem under study before the questionnaires are administered. Four items of the instrument were vetted. The remaining items irrelevant to the research or repeated questions were dropped. After all the adjustments were made, the instruments were adjudged to have met content validity.

To assess the reliability of the LTA instrument, a pilot study was carried out at the University of Ilorin, involving the random selection of 30 lecturers who were then administered the instrument. The collected data was subjected to the Cronbach Alpha reliability test, resulting in a reliability index of 0.911, which is high enough to ensure the instrument's reliability. As highlighted by Koo and Li (2016), an instrument is considered reliable if its calculated reliability coefficient is closer to 1 and less reliable when the calculated reliability coefficient is closer to 0. Data collected was analysed using Statistical Package for Social Sciences (SPSS). The study employs frequency counts and percentages to explain the respondents' demographic data; descriptive statistics of mean were used to answer the research questions.

# 3   Results

## 3.1   Demographic characteristics

The detailed breakdown of the demographic characteristics of the sample population, including their institutional affiliation, gender distribution, and age distribution. These demographic insights could be valuable for various purposes, such as academic planning, resource allocation, or targeted interventions within educational institutions.

(1) Institution: The majority of respondents, 59.4%, are from University 1, 19.7% are from College of Education 2, and 20.9% are from Polytechnic 1.

(2) Gender: Most respondents are male, accounting for 76.3% of the sample, while females account for 23.7%.

(3) Age: The age distribution shows that the most significant proportion of respondents (43.7%) fall within the age range of 41-50. Other considerable proportions include the 31-40 age group (38.2%) and 51-60 age group (13.8%). The remaining age groups (20-30 and 61-70) have smaller percentages.

## 3.2   Descriptive analysis

The descriptive analysis was done by way of answering research questions as follows:

**Research Question One:** What is the level of understanding of technology-integrated curriculum resources among lecturers in tertiary institutions in Sokoto State, Nigeria? This section presents the table containing all the items used to measure the first objective. The research question was analysed using Descriptive statistics of mean as presented in Table 1.

**Table 1**   Level of understanding technology-integrated curriculum resources among lecturers (n = 318)

| S/N | STATEMENTS | N | Mean | SD | Remark |
|-----|-----------|-----|------|------|--------|
| 1 | I understand technology-integrated curriculum resources very well. | 318 | 4.30 | 0.835 | High |
| 2 | I can effectively integrate technology into the curriculum. | 318 | 4.26 | 0.895 | High |
| 3 | I regularly use technology in teaching. | 318 | 3.54 | 1.203 | Low |
| 4 | Technology enhances student learning. | 318 | 4.05 | 1.025 | High |
| 5 | My institution supports me in using technology. | 318 | 4.16 | 0.883 | High |
| 6 | I collaborate with colleagues on technology integration. | 318 | 4.18 | 0.909 | High |
| 7 | I am open to trying new technology tools. | 318 | 3.92 | 0.978 | Low |
| 8 | I attend professional development on technology integration. | 318 | 4.13 | 0.891 | High |
| 9 | I am aware of the benefits of using technology. | 318 | 3.58 | 1.130 | Low |
| 10 | Technology is essential for modern education. | 318 | 3.18 | 1.287 | Low |
| | Weighted Average | | 3.93 | | |

**Source:** Field Survey, 2024.

The results indicate lecturers have a strong understanding and positive attitudes towards technology-integrated curriculum resources, as demonstrated by high mean scores for statements related to understanding (4.30), effectiveness (4.26), and perceived institutional support (4.16). While there is moderate use of technology in teaching (mean = 3.54), lecturers are open to collaboration (4.18) and professional development (4.13) but have a slightly lower belief in the essentiality of technology for modern education (mean = 3.18). This shows that the weighted average mean score across all statements is 3.93, reflecting a generally positive attitude towards

technology integration among lecturers, with variability in some specific beliefs and practices.

**Research Question Two:** How does the inclusion of technology-integrated curriculum resources influence student engagement in tertiary institutions in Sokoto State, Nigeria? This section presents the table containing all the items used to measure the second objective. The research question was analysed using Descriptive statistics of mean as presented in Table 2.

**Table 2**    The influence of technology-integrated curriculum resources on student engagement (n = 318)

| S/N | STATEMENTS | N | Mean | SD | Remark |
|---|---|---|---|---|---|
| 1 | Technology makes learning more interesting for students. | 318 | 2.72 | 1.309 | Low |
| 2 | Students actively participate when technology is used. | 318 | 2.91 | 1.296 | Low |
| 3 | Students are more engaged with technology-integrated lessons. | 318 | 3.63 | 1.244 | High |
| 4 | Students complete assignments more when technology is used. | 318 | 4.00 | 0.940 | High |
| 5 | Students show curiosity when technology is used. | 318 | 3.86 | 0.970 | High |
| 6 | Technology facilitates student collaboration. | 318 | 3.74 | 1.168 | High |
| 7 | Students are enthusiastic when technology is used. | 318 | 3.86 | 1.054 | High |
| 8 | Technology caters to different learning styles. | 318 | 3.45 | 1.301 | Low |
| 9 | Students feel connected to subjects with technology. | 318 | 3.24 | 1.231 | Low |
| 10 | Technology fosters student ownership of learning. | 318 | 3.93 | 0.957 | High |
| | Weighted Average | | 3.53 | | |

**Source:** Field Survey, 2024.

Analysis shows a moderate perceived influence of technology-integrated curriculum on student engagement among 318 participants. Mean scores range from 2.72 to 4.00, with notable variability. Higher ratings for statements like "Students complete assignments more" (mean = 4.00) and "Students show curiosity" (mean = 3.86), lower ratings for "Technology makes learning more interesting" (mean = 2.72) and "Students feel connected to subjects" (mean = 3.24). Weighted average mean score: 3.53, indicating moderately positive perception with variability in impact aspects.

**Research Question Three:** To what extent does integrating technology-enhanced curriculum resources affect students' academic achievement in tertiary institutions in Sokoto State, Nigeria? This section presents the table containing all the items used to measure the third objective. The research question was analysed using Descriptive statistics of mean as presented in Table 3.

**Table 3**    Effect of integrating technology-enhanced curriculum resources on academic achievement of students (n = 318)

| S/N | STATEMENTS | N | Mean | SD | Remark |
|---|---|---|---|---|---|
| 1 | Technology improves student academic performance. | 318 | 3.51 | 1.211 | Low |
| 2 | Students understand complex concepts better with technology. | 318 | 3.66 | 1.106 | High |
| 3 | Students retain information better with technology. | 318 | 3.43 | 1.229 | Low |
| 4 | Technology helps students make real-world connections. | 318 | 3.35 | 1.230 | Low |
| 5 | Technology improves critical thinking skills. | 318 | 3.83 | 1.016 | High |
| 6 | Students master subjects better with technology. | 318 | 3.22 | 1.223 | Low |
| 7 | Students are better prepared with technology. | 318 | 3.74 | 1.137 | High |
| 8 | Technology promotes higher-order thinking. | 318 | 3.52 | 1.124 | Low |
| 9 | Students learn independently with technology. | 318 | 3.92 | 1.021 | High |
| 10 | Technology provides timely feedback. | 318 | 3.78 | 1.050 | High |
| | Weighted Average | | 3.60 | | |

**Source:** Field Survey, 2024.

The analysis indicates a positive impact of integrating technology-enhanced curriculum resources on student academic achievement, based on responses from 318 participants. Mean scores, ranging from 3.22 to 3.92, reflect varying perceptions. Statements concerning understanding complex concepts, learning independently, and receiving timely feedback received higher ratings, denoted as "High" remarks—conversely, statements regarding mastering subjects and making real-world connections showroom for careful exploration. The weighted average mean score is 3.60.

**Research Question Four:** How do socioeconomic, cultural, and infrastructural factors affect the success of integrating technology-enhanced curriculum resources in tertiary institutions in Sokoto State, Nigeria? This section presents the table containing all the items used to measure the fourth objective. The research question was analysed using Descriptive statistics of mean as presented in Table 4.

**Table 4**  Effect of socioeconomic, cultural, and infrastructural factors on the success of integrating technology-enhanced curriculum resources (n = 318)

| S/N | STATEMENTS | N | Mean | SD | Remark |
|---|---|---|---|---|---|
| 1 | Cultural factors affect technology adoption. | 318 | 4.06 | 1.008 | High |
| 2 | Infrastructural factors impact technology integration. | 318 | 4.02 | 0.991 | Low |
| 3 | Socioeconomic disparities affect technology use. | 318 | 4.08 | 0.992 | High |
| 4 | Cultural norms influence technology access. | 318 | 4.16 | 0.959 | High |
| 5 | Inadequate infrastructure poses challenges. | 318 | 4.08 | 0.979 | High |
| 6 | Socioeconomic status affects technology access. | 318 | 4.03 | 1.003 | Low |
| 7 | Cultural attitudes influence technology value. | 318 | 4.10 | 0.985 | High |
| 8 | Socioeconomic status impacts professional development. | 318 | 4.08 | 0.924 | High |
| 9 | Cultural attitudes affect technology integration. | 318 | 4.03 | 0.946 | Low |
| 10 | Infrastructural challenges hinder technology use. | 318 | 3.93 | 1.022 | Low |
| | Weighted Average | | 4.05 | | |

**Source:** Field Survey, 2024.

The impact of socioeconomic, cultural, and infrastructural factors on the success of integrating technology-enhanced curriculum resources was based on responses from 318 participants. Mean scores range from 3.93 to 4.16, indicating varying perceptions. Statements related to cultural factors, infrastructural challenges, and socioeconomic disparities received higher ratings, with a weighted average mean score of 4.05. This suggests a significant perceived influence of these factors on the success of integrating technology-enhanced curriculum resources.

# 4    Discussion of findings

The findings of this investigation offer crucial insights into the impact of technology-integrated curriculum resources on student engagement and academic achievement within the context of tertiary institutions in Sokoto State, Nigeria. This discussion is structured around the constructs of research questions and objectives outlined in the study.

The findings of this study revealed a high level of understanding among lecturers regarding technology-integrated curriculum resources in tertiary institutions in Sokoto State, Nigeria. This aligns with the study of Ojukwu et al. (2021), which highlighted the accelerated adoption of educational technologies due to the COVID-19 pandemic. However, the study of Ojukwu et al. was limited to Imo State, and for that, it needs more generalizability. This study extends its understanding to Sokoto State, contributing to the broader context of technology integration in Nigerian tertiary education.

The findings of this study suggest a moderately positive influence of technology-integrated curriculum resources on student engagement in tertiary institutions in Sokoto State, Nigeria. This is in line with the study of Kriek and Coetzee (2016), which focused on a technology-integrated intervention for first-year physics students. While Kriek and Coetzee provided insights into the benefits of technology integration, this investigation extends beyond a specific subject and year level, enhancing the generalizability of our findings to broader educational contexts.

This research reveals the positive impact of integrating technology-enhanced curriculum resources on student academic achievement in Sokoto State, Nigeria. This aligns with the report of Oloyede et al. (2018) on the need for modern teaching methods in Nigerian engineering education. However, unlike Oloyede et al., who focused on engineering education and did not specifically address technology-integrated curriculum resources, this study examines the effect of technology integration on academic achievement across disciplines.

This investigation reveals a positive influence of these factors on the success of integrating technology-enhanced curriculum resources. This aligns with the findings of Ojukwu et al. (2021), which underscored the influence of contextual factors on technology adoption in education. However, while Ojukwu et al. focused on the Covid-19 pandemic's impact and did not specifically address the role of socioeconomic, cultural, and infrastructural factors, our study delves deeper into these aspects, providing a comprehensive understanding of their effect on technology integration in the educational context of Sokoto State.

# 5    Conclusion

In conclusion, this study explored the influence of technology-integrated curriculum resources on student engagement and academic achievement in tertiary institutions within Sokoto

State, Nigeria. The findings revealed a generally positive perception among lecturers regarding their understanding of technology integration, effectiveness in utilising technology, and institutional support. However, while there was moderate use of technology in teaching, some aspects, such as the belief in the potency of technology for modern education, showed room for improvement. Additionally, the investigation uncovered a moderate perceived influence of technology-integrated curriculum resources on student engagement, with variability in its impact, including learning interest, active participation, and critical thinking enhancement.

The study employed robust analytical methods to ensure a valid representation of the phenomena under investigation. A pilot test of the Lecturers' Technology Adoption Survey (LTAS) was conducted with 30 lecturers from the University of Ilorin to establish reliability, resulting in a Cronbach Alpha coefficient of 0.911, reflecting high internal consistency. This strengthens confidence that the responses accurately capture lecturers' perceptions of the impact of technology-integrated resources. Addressing challenges such as limited technology access, infrastructural constraints, and socioeconomic disparities will be vital for maximising the benefits of technology integration. Policymakers and institutions should prioritise investments in technology infrastructure, offer extensive professional development for educators, and develop tailored strategies to overcome cultural and economic barriers. By strengthening these areas, Nigerian tertiary institutions can more fully harness the potential of technology-integrated resources, ultimately enhancing student engagement, academic achievement, and the overall quality of education provided across diverse learning environments.

# 6    Recommendations

It is vital to address potential challenges alongside each recommendation to maximise the effectiveness of technology-enhanced education. First, while investing in technology infrastructure is essential, limited funding and budget constraints in tertiary institutions may hinder this process. To overcome this, institutions could pursue alternative funding sources, such as government and institutional grants, partnerships with technology companies, or alums contributions. These external support channels can help institutions acquire essential tools, reliable internet, and updated equipment to ensure equitable access to digital resources.

Professional development for educators is another vital recommendation, yet time constraints and resistance to change can pose challenges. Institutions could address these issues by incorporating flexible, on-demand training modules and offering incentives to encourage participation. Additionally, involving educators in designing and selecting training programs could enhance relevance and promote a more significant commitment to technology integration.

Developing clear policies and guidelines for technology integration in curriculum design is beneficial, but it requires stakeholder buy-in and ongoing adaptation to stay relevant to evolving technology. Institutions should promote collaborative planning sessions, including educators' input, to ensure policies are practical and widely accepted. Furthermore, offering incentives for educators who implement technology integration can boost motivation and promote a culture of continuous improvement.

Collaborative partnerships with industry stakeholders offer significant benefits but may encounter logistical and alignment challenges, as academic and industry priorities may differ. Institutions can mitigate this by establishing mutually beneficial partnership goals and maintaining open communication to align expectations. Regular reviews and updates of collaboration terms can keep partnerships productive and relevant to the latest technological advancements.

Conducting periodic evaluations to assess the impact of technology integration can be challenging if institutions need more expertise or resources. Institutions could partner with educational research organisations or hire consultants to guide evaluation efforts. By identifying best practices and areas for improvement through systematic reviews, institutions can refine their strategies, creating a more adaptable and responsive approach to technology-enhanced education.

## Conflicts of interest

The authors declare that they have no conflict of interest.

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