Journal of Education and Practice
ISSN 2222-1735 (Paper) ISSN 2222-288X (Online)
Vol.16, No.2, 2025

Nigerian Secondary Physics Teachers' Perceptions of Factors That Challenge Information and Communication Technology Integration

HemamaliniI Srinivasan (Primary author)
Riley College of Education, Walden University
Washington Ave S, Minneapolis, MN 55401, USA

Michelle McCraney
Riley College of Education, Walden University
Washington Ave S, Minneapolis, MN 55401, USA

Richard Penny
Riley College of Education, Walden University
Washington Ave S, Minneapolis, MN 55401, USA

Sunddip Panesar-Aguilar
Riley College of Education, Walden University
Washington Ave S, Minneapolis, MN 55401, USA

Chris Cale
JFL School of Psychology and Social Sciences, National University
9388 Lightwave Ave, San Diego, CA 92123, USA

Sandricka Luster
American College of Education
101 W Ohio St Suite 1200, Indianapolis, IN 46204

Lorena Harris
American College of Education
101 W Ohio St Suite 1200, Indianapolis, IN 46204

Abstract
Challenges to integrating technology into educational institutions pose a significant issue that impacts students' performance and accomplishments. The research problem addressed through this study was that secondary school physics teachers were challenged to integrate information and communication technology (ICT) in a southwestern state of Nigeria. The purpose of this basic qualitative study was to explore secondary physics teacher perceptions of the factors that challenged ICT integration in the southwestern state of Nigeria, so that schools could be provided with research-deduced recommendations to take informed steps forward toward developing technology-integrated student-centered pedagogies. In this study, the unified theory of acceptance and use of technology served as the conceptual framework. The exploration of secondary school physics teachers' perceptions on the challenges to technology integration was guided by three research questions. These questions were rooted in the conceptual framework consisting of four percepts: effort expectancy, performance expectancy, social influences, and facilitating conditions, all of which collectively influence teachers' adoption of technology in classroom teaching. The subjective sample was comprised of 12 participants who were secondary school physics teachers employed in a single school district. With a basic qualitative approach, data were gathered using an open-ended interview protocol. Subsequently, a thematic analysis of the collected data was conducted, focusing on each of the three research questions. The outcomes of the study coupled with the planned professional development session for secondary school physics teachers in technology integration might result in positive change from more teachers integrating technology with efficacy and fidelity.

Keywords: *Technology education, information technology, communication technology, physics education, information and communication technology*.
DOI: 10.7176/JEP/16-2-06
Publication date: February 28th 2025

1. Introduction

The application of technology in educational settings involves utilizing technological tools for information exchange and communication to inform and shape daily classroom teaching practices (Susanna, 2022). The expeditious growth in educational technology and the availability of technological tools have marked the onset of a new era in reshaping conventional teacher-centered pedagogical practices and shifting the global expectations for a learner-centered education system on educators (Langub, 2019). The Federal Republic of Nigeria's education policy (2013) identified these demands and issued guidelines to activate creative thinking and construct professional competence using current information technologies. However, according to the World Bank (2017), the education system in Nigeria is confronted with various challenges resulting in diminished quality of education, as assessed by students' academic achievements. The performance of secondary school students has been low to such an extent that higher education standards have substantially deteriorated (Birabil et al., 2020). New technologies and information and communication technology (ICT) integration in classroom practices can support students in securing a secondary school leaving certificate with good scores, further assisting them to gain admission into higher institutions of their choice.

Leveraging science and engineering education must be the critical driver of development in countries such as Nigeria, as the 21st-century workforce needs intensified technological skills (Fomunyam, 2019). Physics is the building block of STEM disciplines, and deep learning in secondary school correlates with securing a university degree in the STEM field (Fomunyam, 2019). Teaching and learning physics effectively in this digital era can be easily carried out using ICT tools and gadgets (Bogusevsvschi et al., 2020). Unfortunately, physics teachers in Nigeria still teach using traditional methods that demand ICT integration into the senior secondary school physics curriculum. Despite the extensive advocacy for ICT-aided teaching and learning, there are challenges in integrating ICT to transform senior secondary school students' outcomes and equip them with the skills to face a world that is increasingly dependent on ICT-aided research productivity. The performance of the students at senior secondary schools in physics has been consistently poor and unpromising (National Bureau of Statistics, 2022), the significant factors for this being poor instructional material for teaching and learning. Teachers also experience low self-efficacy in integrating ICT-aided teaching methodologies due to inadequate training in handling ICT tools. This results in poor support for students' physics learning. The apprehension that teachers feel toward using computers presents difficulties, leading to limited ICT integration in teaching strategies (Awofala et al., 2019). Additionally, there is an inadequacy of professional development (PD) sessions and training programs to assist teachers in easing the difficulty in comprehending the concepts of physics (Samaila et al., 2021).

Recent Studies Employing the Unified Theory of Acceptance and Use of Technology for Technology Integration

Many researchers in education have used the principles of the UTAUT as the concept underpinning their studies in technology integration. The problems encountered by UAE secondary school teachers in integrating technology and building smart classrooms were investigated by Mohamed and Rahman (2023) through the UTAUT model. This model also illuminated the causes and influences affecting the adoption of microlectures among Chinese mathematics teachers and the impact of behavioral attitudes of teachers for successful blending of technology in mathematics classes (Wijaya et al., 2022). The aspects of classroom pedagogy affecting Filipino secondary teachers' adoption of ICT-based instruction were also established based on the UTAUT model (Kim & Lee, 2020). The education policy adopted by educational institutions and teachers' ICT usage habits directly influenced the integration of technology in curricula and pedagogy (Kim & Lee, 2020). Rahman et al. (2021) employed the UTAUT framework to examine how the adoption of a flipped learning approach, coupled with technology, enhances critical thinking skills among students in ESL classrooms. The study revealed that teachers' confidence in their pedagogical abilities and their perceptions and beliefs on organizational and infrastructural support significantly influenced their comfort and proficiency in using ICT. This aligns with the UTAUT's assertion that favorable facilitating conditions are key to teachers adopting ICT in their instructional strategies (Kundu et al., 2021).

The Unified Theory of Acceptance and Use of Technology's Influence on Research Questions

Nigerian secondary school teachers face barriers that impede blending technology in their pedagogies. To identify and comprehend the reasons for ICT integration, this research employed the conceptual framework of the UTAUT, which consists of four key concepts propounded by Blut et al. (2022) and Venkatesh et al. (2016). In framing the three research questions, these four concepts were integrated for the UTAUT. The purpose of this approach was to explore teacher perceptions related to the model of the UTAUT, ultimately shedding light on how these concepts guide teachers' efforts to blend technology in their classrooms' pedagogy.

Review of the Broader Problem

Integrating ICT for enhanced instructional and educational outcomes brings in struggles. As reported by Awofala et al. (2019), blending ICT into education is highly influenced by one's attitude toward computers, the level of tech-related apprehension experienced, and the degree of computer competence. Teachers have intense concerns regarding awareness of, management of, and information on ICT integration (Dele-Ajayi et al., 2021). A reoccurring theme in research is that teachers often view the integration of ICT in their curriculum as a threat to conventional teaching. The effective utilization of ICT facilities in secondary school education is contingent upon teachers' readiness, the availability of supporting conditions, their beliefs in the technological value, and participation in professional training sessions (Jimoh et al., 2020). Professional training programs focused on developing technology skills can increase teachers' technology acceptance and utilization, regardless of their inexperience and unfamiliarity with ICT tools (Akram et al., 2022; Jadhav et al., 2022). Consistent with the framework chosen for the study, this review subsection delves into research works carried out in the last 5 years examining the problem being studied and exploring the ease with which teachers adopt ICT as well as the effort and performance expectations associated with blending technology in their classrooms.

Recent Studies About ICT Integration in Secondary School Physics Education

It is evident from literature that ICT integration in teaching secondary school physics is more challenging due to the abstract concepts involved in the subject (Tenzin et al., 2022). Nevertheless, some researchers (Samaila et al., 2021) have indicated that students performed better in secondary-level physics when good-quality ICT resources were integrated in classroom teaching. A cross-sectional survey designed by Kamati and Shikongo (2023) revealed that the availability of instructional technologies significantly impacted the academic performance of students. Failure to adopt ICT-integrated techniques and following the traditional teacher-centered teaching strategies had a negative impact on student achievements in physics exams conducted at secondary school levels (Kamati & Shikongo, 2023), a problem that has also occurred in the state under study.

To understand teachers' views on and needs for integrating technology, Pappa et al. (2023) used a qualitative research method. The authors' study combined deductive and inductive mixed-method approaches of the semistructured interviews with 21 public school teachers, finding a critical lack of emphasis on preservice teacher training in technology-integrated pedagogy, resulting in limited ICT-integrated teaching practices. The findings also recommended PD programs to boost teachers' technological pedagogical content knowledge (TPACK), confidence, and self-efficacy and decrease inhibitions while integrating technology (Pappa et al., 2023). Ouahi et al. (2022) also studied ICT use in physics-chemistry and life sciences and concluded that despite obstacles that hinder the use of classroom technology, teachers and students were equally benefitted by technology-integrated science teaching and learning.

1.1 Background of the Study

The Problem

The research problem addressed through this study was that secondary physics teachers were challenged to integrate information and communication technology (ICT) in a southwestern state of Nigeria. A first piece of evidence that this problem exists was provided by Ifinedo and Kankaanranta (2021). Although the Nigerian national policy on education stresses the importance of ICT in improving student outcomes, lack of initiatives by administrators and effective strategies by secondary teachers have resulted in a struggle for technology integration in Nigerian classrooms (Ifinedo & Kankaanranta, 2021). Opeyemi et al. (2019) furnished the second piece of evidence in a case study of Nigerian teachers conducted on the barriers to integration of digital technologies in classrooms. Despite a strong interest among secondary students in embracing technology and the growing development of ICT tools, along with increased access to digital devices, the process of integrating and utilizing technological advancements within the Nigerian schooling system has not accelerated as rapidly as expected (Opeyemi et al., 2019). The existence of the research problem was further reiterated by Jimoh (2019). In many Nigerian schools, secondary-level teachers lack the necessary technological expertise to blend ICT into their pedagogy, compelling them to adhere to conventional chalk-and-duster teaching approaches (Jimoh, 2019).

A significant number of states in Nigeria have not fully embraced adoption of ICT tools for teaching,

resulting in a limited influence of the initiatives aimed at ICT in the secondary school curriculum (Bolaji & Jimoh, 2023). The research study focused on a city in one such state in southwestern Nigeria where teachers faced challenges to integrating technology in the secondary school physics curriculum. This city comprises six education districts providing education to over 200,000 senior secondary school students. The pupil-qualified teacher ratio in public senior secondary schools reaches as high as 45, making it increasingly difficult for the teachers to practice conventional style teacher-centered pedagogy in the classrooms. The strategic integration of ICT within educational contexts can effectively enhance the pedagogical process for both educators and learners. This can be achieved through the improved delivery of instructional materials, supporting students' creativity and the cultivation of problem-solving skills (Bolaji & Jimoh, 2023). However, technology integration and adaptation to ICT tools to move away from teacher-subjugated teaching methods toward the newest educational system developments are far from having reached Nigerian public-senior secondary schools, according to the tutor-general permanent secretary of the state under study. Without addressing this problem, further deterioration in the students' outcomes in secondary school physics is possible.

1.1.1 *Purpose of the Study and Research Questions*

The purpose of this basic qualitative study was to explore secondary physics teachers' perceptions of factors that challenged ICT integration in a southwestern state in Nigeria. Integration of ICT is not just another way of teaching the concepts of physics but can make learning more relevant and linked to real life and instill self-directed learning in students. The secondary physics teachers of the state under study were unable to blend technology to its full potential. Drawing upon the unified theory of acceptance and use of technology (UTAUT) (Venkatesh et al., 2003), research questions were designed to analyze teachers' perceptions of the barriers to ICT integration in physics classrooms. The outcomes of this analysis can potentially address these challenges and pave the way for enhanced cooperation between state education leaders and teachers, resulting in improved student outcomes.

RQ1: What are Nigerian secondary teachers' perceptions about integrating ICT into the physics curriculum?

RQ2: What are secondary physics teachers' perceptions of the facilitating conditions that challenge ICT integration in the state under study in Nigeria?

RQ3: What are secondary physics teachers' perceptions of the resources needed for ICT integration in the state under study in Nigeria?

2. Methodology and Sample

This study used a qualitative research method approach to answer the research questions. Semistructured interviews allowed for the gathering of in-depth information and participant perspectives while maintaining a focus on the core research questions, ensuring that the study remained grounded (see Creswell & Creswell, 2018). **This research employed purposive sampling to target secondary physics teachers with demonstrable knowledge and experience in the curriculum. Germane to the research focus, data collection strategies, and the intended application of the findings, a qualitative study was determined to be the tailor-made solution.**

Purposive sampling strategy was used to identify 12 physics teachers from one of the education districts of the state under study who met the established criteria for participation. Purposive sampling ensured that the selected participants possessed the relevant experiences and characteristics to provide rich and informative data within the context of the research questions. Each of the 12 participating teachers provided informed consent before engaging in online semistructured interviews. The online platform facilitated data collection despite geographical constraints.

3. Data Analysis and Results

Table 1 depicts participant identifier, years of instructional expertise, and grade levels handled by the teacher-participants. Participants included nine men and three women, all located in district I of the state under study in Nigeria. The participants' teaching tenure varied from 5 to 24 years, experienced in handling senior secondary physics classes, both in traditional mode, predominantly, and in ICT-integrated modes.

Table 1
Teacher-Participants' Identifiers and Experience

Participant	Years of teaching	Senior secondary levels taught
P1	16	1–3
P2	5	1–3
P3	14	2–3
P4	8	1–3
P5	5	1–3
P6	24	1–2
P7	8	2–3
P8	10	1–2
P9	13	1–3
P10	24	2–3
P11	7	1–3
P12	11	1–3

Individual semistructured interviews were conducted with 12 secondary school physics teachers to gather qualitative data. Each teacher-participant was allocated a numerical identifier to safeguard anonymity and facilitate data organization.

Three themes each were formed to examine each research question individually. Theme 1 focuses on secondary school physics teachers' belief in effective instructional strategies to explain complex concepts in physics and present the concepts to students in an easier way. Theme 2 indicates physics teachers' desire to blend technology productively in their classrooms to simplify abstract physics concepts. Theme 3 spotlights the enhancement in student outcomes in physics with technology integrated instructional practices. Table 2 summarizes the connection between codes and themes aligned with RQ1.

RQ1: What are Nigerian secondary teachers' perceptions about integrating ICT into the physics curriculum?

Table 2
Codes and Themes Identified in Relation to RQ1

Codes	Themes
1. Abstract physics 2. Comprehend 3. Instructional materials 4. Manual methods	1. Physics is a complex subject that requires effective instructional methodologies to elucidate and deliver it to students.
5. Technology-driven teaching 6. Flipped classroom 7. Easy-to-understand 8. Real-life connection 9. Visualize physics	2. Technology integration in teaching simplifies and strengthens the understanding of abstract physics concepts.
10. Simulations 11. Theory with practice 12. Student engagement 13. Improved interest 14. Morale boost 15. Exam results	3. Technology integration in teaching ensures enhanced student engagement in learning and improves student outcomes in physics.

The second set of three themes were formed to align with the second research question framed. Theme 4 points out the complexities encountered by secondary school physics teachers in their attempts to integrate technology

in their instructional methodologies. Theme 5 highlights the expectations of the school administration on its teachers to blend technology in instructional pedagogies. Theme 6 emphasizes that secondary school physics teachers in the state under study received very limited support from their school administration for integrating ICT in their classroom instructional strategies. Table 3 maps the codes used in the analysis of the corresponding themes that addressed RQ2.

RQ2: What are secondary physics teachers' perceptions of the facilitating conditions that challenge ICT integration in the state under study in Nigeria?

Table 3
Codes and Themes Identified in Relation to RQ2

Codes	Themes
16. Unstable power supply 17. Inaccessibility of internet 18. Limited digital tools/devices 19. Large class strength 20. Ill-equipped ICT labs	4. Secondary school physics teachers faced challenges when integrating technology in instructional methodology.
21. Use of technology 22. Implementation 23. Motivation 24. Negative attitudes	5. Secondary school physics teachers believed their school administration expected regular use of technological instructional strategies.
25. Administrative support 26. Software/hardware support 27. In-house professional support 28. Personal devices/gadgets 29. Running costs 30. Projectors/smart boards	6. Secondary school physics teachers received very limited support from their administrative division

The last three themes were formed to align with the third research question framed. Theme 7 focuses on secondary school physics teachers' requirement for consistent support from their school administration and government authorities for successful ICT integration. Theme 8 highlights the beliefs of the teachers on professional development and training for strengthening their digital skills. Theme 9 draws attention to the aspirations of the teachers to learn and be trained to effectively integrate ICT in classroom practices and deliver physics as a fun-to-learn subject. Table 4 explores the link between the codes and themes derived for RQ3.

RQ3: What are secondary physics teachers' perceptions of the resources needed for ICT integration in the state under study in Nigeria?

Table 4
Codes and Themes Identified in Relation to RQ3

Codes	Themes
31. Financial support 32. Interactive boards 33. Well-equipped ICT labs 34. Uninterrupted power supply 35. Affordable Wi-Fi connection	7. Secondary school physics teachers required strong support from the school administration and the local government for effective ICT integration.
36. Paid web applications 37. Effective teacher training 38. Mental health 39. Professional development 40. Grooming	8. Secondary school physics teachers perceived professional training and development to support their use of ICT in classroom teaching practices.
41. Teachers' confidence 42. Blended classrooms 43. Modern instructional strategies 44. Self-development	9. Secondary school physics teachers yearned to learn from training sessions to create classrooms that incorporated a fun-way of learning physics.

Guided by the three research questions and an effective data analysis, a thematic coding approach was coded. This approach facilitated the elucidation of nine distinct themes emerging from the interview data. By presenting the themes alongside their corresponding research question, as seen in Table 5, the comprehension of the analysis is enhanced. Table 5 presents a clear overview of the thematic connections and guides through the investigation of specific aspects of teacher experiences with technology integration, as explored in each research question.

Table *5*
Themes' Convergence With Research Inquiries

Themes	Research questions
1. Physics is a complex subject that requires effective instructional methodologies to elucidate and deliver it to students. 2. Technology integration in teaching simplifies and strengthens the understanding of abstract physics concepts. 3. Technology integration in teaching ensures enhanced student engagement in learning and improves student outcomes in physics.	RQ1: What are Nigerian secondary teachers' perceptions about integrating ICT into the physics curriculum?
4. Secondary school physics teachers faced challenges when integrating technology in instructional methodology. 5. Secondary school physics teachers believed their school administration expected regular use of technological instructional strategies. 6. Secondary school physics teachers received very limited support from their administrative division.	RQ2: What are secondary physics teachers' perceptions of the facilitating conditions that challenge ICT integration in the state under study in Nigeria?
7. Secondary school physics teachers required strong support from the school administration and the local government for effective ICT integration. 8. Secondary school physics teachers perceived professional training and development to support their use of ICT in classroom teaching practices. 9. Secondary school physics teachers yearned to learn from training sessions to create classrooms that incorporated a fun-way of learning physics.	RQ3: What are secondary physics teachers' perceptions of the resources needed for ICT integration in the state under study in Nigeria?

4. Conclusions

The results of this study indicated how teachers' experiences and perceptions informed techniques to be adopted for effective ICT integration in physics education, in the target state. The first theme resonated with existing literature on physics education, where the abstract nature is often identified as a barrier to student understanding. However, the teachers' voices in this study enriched this conversation by offering practical insights and diverse perspectives. The teacher-participants' experiences and their answers to the initial set of questions highlighted the need for innovative instructional methodologies that addressed the abstractness of physics head-on, fostering deeper student engagement and understanding.

Aligned with RQ1, the second theme laid emphasis on the practical applications of ICT integration, suggesting that the teachers recognize the potential of technology to simplify and enhance student comprehension of abstract topics in secondary school physics curriculum. The theme also revealed concerns among some participants regarding the prevalence of traditional teaching methods within their schools. These concerns pointed towards barriers faced by secondary school physics teachers in constructively blending ICT into their existing instructional design.

The third theme affirmed the crucial role played by technology integration in boosting student engagement and academic achievement. Participants acknowledged the effectuality of interactive simulations that can bring complex physics concepts to life, resulting in better comprehension of the underlying principles. Technology-driven classroom practices shifted the focus from didactic to inquiry-based learning, enhancing student participation, sparking curiosity, and igniting passion for the subject. Consequently, secondary school students became more invested in the learning process, resulting in improved academic achievement in physics.

The fourth theme brought out the barriers hindering the ICT integration in secondary school physics classroom, in the state under study. Electricity issues, limited digital devices, and inadequate school infrastructure were identified as significant obstacles to ICT-integration, as reported by the teacher-participants. This theme found that unreliable and insufficient internet access hindered the access to online educational resources. A critical shortage of digital devices in the school ICT labs and limited access to technology at home led to unequal access for students. This restricted technology access prevented some students to keep pace with their peers, having a greater impact on their academic performance and future academic opportunities. Overall, teachers' perceptions indicated the major role played by reliable access to online educational software and tools, strong school infrastructure, and digital hardware availability in facilitating successful ICT integration within secondary school physics classrooms.

The fifth theme acknowledged that a significant portion of the secondary school physics teachers believed their school administration expected regular use of technological instructional strategies, aligned with the social influence aspect of the UTAUT framework. Valuable insights with regard to effective pedagogical practices for ICT-integrated physics education, even under circumstances when appropriate technological tools are insufficient in school buildings, were shared by the participants. A fundamental disconnect between physics teachers and their school administration regarding the support teachers require for effective ICT integration was identified. Administrators' commitment to student engagement transcending limitations and paving way for transformative learning experiences were also put forth by a few participants. Collectively, teachers perceived the various challenges to ICT integration and the inadequate support from the school administration to constrain their capacity to effectively utilize technological resources for creating engaging and joyful learning experiences in physics classrooms.

The sixth theme sought to uncover the nature of support, hardware, and software, from the school administration for technology use, its effect on teachers' classroom practices, student engagement, and students' academic achievements. Teacher-participants' responses to the set of interview questions leading to Theme 6 contributed valuable insights into the important issue of limited support in school environment, unfavorable to effective technology integration in physics education. Data analysis also revealed diverse experiences among participants concerning the level of hardware and software support provided by their school administration. Additionally, the extent of the broader support offered by the administration varied considerably.

The seventh theme explored teacher expectations of the support required for successful blending of ICT in the secondary school educational settings in the target state. Teachers expected the school administration and the government to identify funding mechanisms to support the acquisition of adequate hardware, software, and digital applications and supplement teacher incentives. Teacher-participants perceived that educational resources should be created, and support structures should be developed to ensure effective use of ICT in learning. Additionally, teachers expressed their wish to move beyond a purely technological approach to ICT integration and focus on comprehensive support to teachers, students, and parents alike to unlock the effectiveness of ICT-blended methods to improve teaching, learning, and engagement within the educational settings.

The eighth theme identified a perceived need for professional development opportunities to bolster secondary physics teachers' confidence and competence in utilizing ICT within their classroom pedagogy. Teachers expressed their desire for professional training that would extend beyond technical proficiency and focus on integrating technology meaningfully within the specific context of physics education. Concerns regarding insufficiency of digital resources and unreliable electricity supply were reiterated by the participants. Analysis of interview transcripts revealed that such an insufficiency impeded the successful application of the knowledge and skills acquired by teachers from professional development sessions.

The ninth theme brought out the interest in secondary school physics teachers to learn from training programs and blend technology in their pedagogies. This interest extended beyond personal use for their own students, with participants advocating for training that would empower them to share these resources with the wider teaching community, ultimately benefiting a broader student population. A vision of physics teachers to independently create digital learning resources and eliminate the need for purchasing paid applications, evolved during data analysis. This vision underscored the resourcefulness of some teachers and their commitment to finding cost-effective solutions to enhance the learning experience of students.

A consistent theme that recurred throughout data analysis of the current study was that all interview participants expressed a strong desire in acquiring skills to create digital resources. Additionally, majority of the participants also revealed their inclination towards using simulations to simplify complex concepts in physics. However, despite receiving professional training and acquiring technological skills, a paramount concern emerged among participants. The participants expressed uncertainty regarding the feasibility of implementing the acquired skills due to limitations within their educational environment. These limitations included inadequate digital tools, unreliable internet connectivity, inconsistent power supply, and the lack of readily available alternative power sources.

The prospective impact of this research study go beyond academic boundaries. By advocating for teachers' professional development and efficacious teachers' training, this research recommends empowerment of teachers to utilize technology effectively, leading to increased job satisfaction and professional growth. By addressing challenges to ICT access within state schools, this research can contribute to closing the digital divide and equipping students with essential 21st-century technological skills. The proposed recommendations, if implemented, could significantly enhance the integration of ICT in physics education across schools in the studied state, yielding positive student outcomes.

References

Akram, H., Abdelrady, A. H., Al-Adwan, A. S., & Ramzan, M. (2022). Teachers' perceptions of technology integration in teaching-learning practices: A systematic review. *Frontiers in Psychology*, *13*, Article

920317. https://doi.org/10.3389/fpsyg.2022.920317

Awofala, A. O., Olabiyi, O. S., Awofala, A. A., Arigbabu, A. A., Fatade, A. O., & Udeani, U. N. (2019). Attitudes toward computer, computer anxiety and gender as determinants of pre-service science, technology, and mathematics teachers' computer self-efficacy. *Digital Education Review*, *36*, 51–67. https://files.eric.ed.gov/fulltext/EJ1238929.pdf

Birabil, D., Tete, S., Ogeh, D., & Matthew, O. W. (2020). Education in Nigeria: Challenges and way forward. *International Journal of Academic Research and Reflection, 8*(1), 42–48. http://www.idpublications.org/wp-content/uploads/2020/04/Full-Paper-EDUCATION-IN-NIGERIA-CHALLENGES-AND-WAY-FORWARD.pdf

Blut, M., Chong, A., Tsiga, Z., & Venkatesh, V. (2022). Meta-analysis of the unified theory of acceptance and use of technology (UTAUT): Challenging its validity and charting a research agenda in the red ocean. *Journal of the Association for Information Systems, 23*(1), 13–95. https://doi.org/10.17705/1jais.00719

Bogusevschi, D., Muntean, C., & Muntean, G. M. (2020). Teaching and learning physics using 3D virtual learning environment: A case study of combined virtual reality and virtual laboratory in secondary school. *Journal of Computers in Mathematics and Science Teaching*, *39*(1), 5–18. https://eric.ed.gov/?id=EJ1248093

Bolaji, H. O., & Jimoh, A. (2023). Usability and utilization of ICT among educational administrators in secondary students in public school. *Indonesian Journal of Educational Research and Technology, 3*(2), 97–104. https://doi.org/10.17509/ijert.v3i2.48244

Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). Thousand Oaks, CA: SAGE Publications.

Dele-Ajayi, O., Fasae, O. D., & Okoli, A. (2021). Teachers' concerns about integrating information and communication technologies in the classrooms. *Plos one*, *16*(5), e0249703. https://doi.org/10.1371/journal.pone.0249703

Federal Ministry of Education. (2013). *National policy on education* (6th ed.). Nigerian Educational Research and Development Council. https://educatetolead.files.wordpress.com/2016/02/national-education-policy-2013.pdf

Fomunyam, K. G. (2019). Teaching STEM education in Nigeria: Challenges and recommendations. *International Journal of Mechanical Engineering and Technology, 10*(12), 85–93. https://ssrn.com/abstract=3526166

Ifinedo, E., & Kankaanranta, M. (2021). Understanding the influence of context in technology integration from teacher educators' perspective. *Technology, Pedagogy and Education*, *30*(2), 201–215. https://doi.org/10.1080/1475939X.2020.1867231

Jadhav, P., Gaikwad, H., & Patil, K. S. (2022). Teaching and learning with technology: Effectiveness of ICT integration in schools. *ASEAN Journal for Science Education, 1*(1), 33–40. https://ejournal.bumipublikasinusantara.id/index.php/ajsed/article/view/33

Jimoh, A. (2019). ICT skills as an aid to teaching and learning in Nigeria: Challenges and prospectus. *Saudi Journal of Business and Management Studies, 4*(7), 629–633. https://www.saudijournals.com/media/articles/SJBMS_47_629-633.pdf

Jimoh, A. S., Bamiro, N. B., Akapo, T. A., Ibrahim, D. A., & Ismaila, M. A. (2020). Survey of determinants of the utilization of ICT facilities for instruction in Lagos State secondary schools [PDF]. Al-Hikmah Journal of Education, 7(2), 42–53. https://www.alhikmah.edu.ng/ajhir/index.php/aje_path/article/view/135/136

Kamati, P. K., & Shikongo, J. (2023). Assessment of instructors' ability to incorporate technology into physics teaching in Namibia. *Global Journal of Physics and Applied Sciences, 1*(1), 1–13. https://gprjournals.org/journals/index.php/GJPAS/article/view/112

Kim, J., & Lee, K. S. S. (2020). Conceptual model to predict Filipino teachers' adoption of ICT-based instruction in class: Using the UTAUT model. *Asia Pacific Journal of Education*, *42*(4), 699–713. https://doi.org/10.1080/02188791.2020.1776213

Kundu, A., Bej, T., & Dey, K. N. (2021). Investigating effects of self-efficacy and infrastructure on teachers' ICT use, an extension of UTAUT. *International Journal of Web-Based Learning and Teaching Technologies (IJWLTT)*, *16*(6), 1–21. https://doi.org/10.4018/IJWLTT.20211101.oa10

Langub, M. K. C. (2019). Development and validation of scale on technology integration in physics class (STIPC) for junior high school science teachers. *European Journal of Education Studies, 6*(2), 287–298. https://oapub.org/edu/index.php/ejes/article/download/2452/5090

Mohamed, A. A., & Rahman, A. A. (2023). Factors affecting secondary school teachers' intention to use education 4.0 in UAE: A UTAUT analysis. *Malaysian Journal of Social Sciences and Humanities (MJSSH), 8*(4), e002254. https://doi.org/10.47405/mjssh.v8i4.2254

National Bureau of Statistics. (2022). *WAEC Results Statistics 2019-2021* [PDF]. https://nigerianstat.gov.ng/download/1241213

Opeyemi, D. A., Ayodele, V., Alufa, O., Anderson, E., Strachan, R., & Emembolu, I. (2019, April). Barriers and identified solutions to the integration of digital technologies in the classroom: A case study of teachers in Nigeria. In *2019 IEEE Global Engineering Education Conference (EDUCON)* (pp. 953–958). IEEE. https://ieeexplore.ieee.org/abstract/document/8725160/

Ouahi, B. M., Lamri, D., Hassouni, T., Ibrahmi, A., & Mehdi, E. (2022). Science teachers' views on the use and effectiveness of interactive simulations in science teaching and learning. *International Journal of Instruction*, *15*(1), 277–292. https://files.eric.ed.gov/fulltext/EJ1331043.pdf

Pappa, C. I., Georgiou, D., & Pittich, D. (2023). Technology education in primary schools: Addressing teachers' perceptions, perceived barriers, and needs. *International Journal of Technology and Design Education,* 1–19. https://doi.org/10.1007/s10798-023-09828-8

Rahman, S. F., Md Yunus, M., & Hashim, H. (2021). Applying UTAUT in predicting ESL lecturers' intention to use flipped learning. *Sustainability*, *13*(15), 8571. https://doi.org/10.3390/su13158571

Samaila, K., Dauda, S., Aliyu, M., & Aliero, A. A. (2021). Application of ICTs and educational software in teaching physics: Advantages, challenges, and proposed solutions. *International Journal of Research and Review, 8*(1), 293–304. https://www.academia.edu/download/76906351/IJRR031.pdf

Susanna, V. (2022). Information and communication technologies in education [PDF]. *Eurasian Journal of Learning and Academic Teaching, 6*, 89–93. https://geniusjournals.org/index.php/ejlat/article/view/902

Tenzin, S., Tendar, P., & Zangmo, N. (2022). Enhancing students' understanding of abstract concepts in physics by integrating ICT in teaching-learning process. *Asian Journal of Education and Social Studies, 26*(2), 68–80. https://doi.org/10.9734/ajess/2022/v26i230624

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance information technology: Toward a unified view. *Management Information Systems Quarterly, 27*(3), 425–478. https://doi.org/10.2307/30036540

Venkatesh, V., Thong, J. Y., & Xu, X. (2016). Unified theory of acceptance and use of technology: A synthesis and the road ahead. *Journal of the Association for Information Systems*, *17*(5), 328-376. https://www.academia.edu/download/74627454/SSRN_id2800121.pdf

Wijaya, T. T., Cao, Y., Weinhandl, R., Yusron, E., & Lavicza, Z. (2022). Applying the UTAUT model to understand factors affecting micro-lecture usage by mathematics teachers in China. *Mathematics*, *10*(7), 1008. https://doi.org/10.3390/math10071008

World Bank. (2017). Federal Republic of Nigeria World Bank Program-for-results: Financing better education service delivery for all (BESDA). *Environment and Social Systems Assessment (ESSA),* (P160430). https://documents.worldbank.org/curated/en/577861487889380249/pdf/113006-REVISED-EA-P160430-Box402908B-PUBLIC-Disclosed-5-8-2017.pdf