

Physics Student Academic Achievement at the Interface of Teacher Attitude towards ICT and ICT Usage

Afeez T. Jinadu

Nigerian Institute of Social and Economic Research Ibadan, Nigeria

Jamiu O. Amusa

Lead City University International School Ibadan, Nigeria

ABSTRACT

The study focused on teachers' attitude, teacher ICT usage and students' academic achievement in Physics in Ibadan. The study adopted an ex-post facto design of non-experimental research. All teachers and students in Ibadan North were the target population for the study. The study used a multi stage sampling technique to select 105 participants. Three instruments; Teacher Attitude to ICT Questionnaire-TAIQ ($r=0.86$), Teacher ICT Usage Questionnaire-TIUQ ($r=0.78$) and Physics Achievement Test-PAT ($KR_{20}=0.83$) were used to collect data. Data collected were analysed by correlation and multiple regression. There was a significant positive relationship between teachers' attitudes toward ICT and students' performance in Physics ($r = 0.542$, $p < 0.05$), and between ICT usage and students' performance in Physics ($r = 0.521$, $p < 0.05$). Teacher attitude towards ICT and ICT usage jointly accounted for 52.7% of the variance in students' performance in Physics ($R^2 = 0.565$). Teachers' attitudes toward ICT contributed more ($\beta = 0.346$, $p < 0.05$) followed by ICT usage ($\beta = 0.268$, $p < 0.05$). A positive attitude among teachers toward ICT and consistent ICT integration into teaching significantly enhanced students' academic performance in physics. Schools should provide improved access to ICT infrastructures and encourage teachers to form positive attitude towards ICT.

Keywords: *Education; flexible delivery; blended learning; communication technology*

INTRODUCTION

Physics is a key area of science that is vital for comprehending natural events and fostering technological progress. It offers the essential ideas that support many scientific and engineering fields, such as mechanics, thermodynamics, electromagnetism, and quantum mechanics. Understanding physics is crucial for driving innovations in areas like healthcare, communication, transport, and energy generation, making it a vital component of the high school curriculum (Okafor & Anene, 2020). Studying physics helps students enhance their critical thinking, analytical skills, and problem solving abilities, all of which are necessary for scientific development and the growth of the nation (Adegoke, 2019). Moreover, it helps students gain a solid grasp of fundamental scientific principles and their uses; cultivates scientific skills and mindsets as necessary foundations for more advanced scientific endeavors; acknowledges the strengths and weaknesses of scientific approaches to understand their relevance in other fields and daily life; fosters skills, attitudes, and abilities that support safe and efficient practices; and promotes scientific related attitudes like valuing accuracy, objectivity, integrity, creativity, and resourcefulness (Jinadu, 2024a; Jinadu, 2024b).

In Nigeria, the education of physics is crucial because it plays a key role in the country's development in industry and technology. Innovations in physics have resulted in significant progress, from energy production to space missions, which support economic growth and enhance living standards (Bello, 2021). Physics can be seen in many daily life areas, such as improving public transport, creating medical imaging tools, and developing renewable energy sources

(Ogunleye, 2021). Hence, it is essential to provide students with a solid understanding of physics to cultivate a workforce that can tackle modern scientific and technological issues.

Physics is an essential academic discipline with extensive effects on technology and economic growth. To ensure successful physics education in Nigeria, it is necessary to overcome current obstacles, enhance teacher training, and upgrade laboratory resources. By promoting an environment of scientific interest and providing students with vital skills, Nigeria has the opportunity to nurture a generation of physicists, engineers, and innovators who will lead advancements in the 21st century. Recognizing the important function of physics in the nation's progress, it is crucial to implement strategies that boost student engagement and achievements in this field. Incorporating practical experiments, relating physics ideas to real world situations, and using engaging teaching methods can help students better understand complex concepts (Iji, Abah & Anyor, 2018). Furthermore, ensuring that there is sufficient funding for lab tools, the training of educators in modern teaching techniques, and encouraging a favorable perception of physics among learners, can greatly enhance educational results (Yusuf & Balogun, 2019).

The teaching and study of physics in secondary schools in Nigeria encounter multiple difficulties, including negative views about the subject, limited student interest, and poor academic results among others. A lot of students find physics hard and abstract because of its complicated mathematical theories and concepts (Eze, 2020). This negative viewpoint, along with insufficient teaching resources and inadequately equipped labs, has led to reduced interest and low academic success among learners (Ukwueze, 2021). Results from national examinations show that physics consistently has one of the lowest pass rates in comparison to other science subjects, which emphasizes the necessity for better teaching techniques and greater student involvement (WAEC, 2020).

Although physics is an academic subject, student results in Nigerian secondary schools indicate that it continues to be a major issue. Numerous students have a hard time grasping essential physics ideas, which is clear from their ongoing poor performances in standardized tests. The West African Examinations Council (WAEC) results from recent years indicate that physics ranks as one of the lowest in pass rates among science subjects. Literature indicates several reasons behind this issue, such as the abstract nature of physics, lack of proper teaching materials, and insufficient access to functional laboratories. Furthermore, many students show little motivation or interest for the subject, viewing it as challenging and meaningless to their everyday experiences. The attitudes of teachers towards ICT and its integration into teaching represent new aspects that require further investigation.

Teachers' attitudes include their beliefs, views, and feelings about teaching practices, tools, and methodologies. In this study, it specifically refers to how teachers regard and implement ICT in their teaching approaches. A favorable attitude towards ICT is shown by a willingness to embrace new technologies, excitement for incorporating digital tools into lessons, and a readiness to learn and grow with technological improvements. On the other hand, a negative stance may lead to opposition to change, hesitance to use ICT, or minimal interaction with available resources. Research shows that educators who maintain a positive attitude towards ICT are more inclined to foster engaging, student focused learning environments that improve students' understanding and performance in physics (Yusuf & Balogun, 2019).

Teachers' perspectives on ICT are vital in determining the degree of technology use in classroom teaching. Studies have demonstrated that educators who see ICT as advantageous are more inclined to include it in their teaching plans and methods (Ajayi, 2020). Their confidence in utilizing digital resources impacts how effectively they utilize technology to improve student learning results. Consequently, teachers' attitudes can either promote or hinder the incorporation of ICT in education. A strong desire to adopt ICT can foster creative teaching methods that make learning

physics more practical, interactive, and fun. Conversely, hesitation to use ICT can lead to stagnation, where outdated teaching methods predominate in classrooms, limiting students' access to contemporary learning tools.

One important element that affects how teachers feel about information and communication technology, or ICT, is their understanding of digital skills. Teachers who are skilled in using digital resources usually have a more favorable view of ICT, while those who are not confident may find technology daunting and hesitate to use it (Okebukola, 2018). Offering proper training and professional development opportunities can help reduce this barrier and promote a more optimistic attitude towards ICT among teachers. Training in digital literacy should not only concentrate on technical abilities but also include teaching methods that allow educators to incorporate ICT naturally into their lessons. When teachers recognize the educational advantages of ICT, they are more inclined to gain confidence in using it and explore various digital tools to enhance student interest and understanding.

Given the essential part teachers play in successfully using ICT, encouraging a positive outlook towards technology in education is crucial. Tackling issues related to digital skills, institutional backing, concerns about workload, and resistance to change can greatly improve teachers' readiness to adopt ICT. When educators regard technology as an asset instead of a barrier, they are more likely to foster vibrant, student-centered learning environments that enhance academic achievement. Ongoing training, collaboration among peers, and organized implementation methods will further boost teachers' self-assurance in utilizing ICT, ultimately enhancing the educational experience in physics and other subjects. As education authorities and institutions continue to highlight the importance of digital learning, it is vital to ensure teachers have the right mindset and support to successfully integrate ICT in physics education.

The application of ICT refers to how teachers use information and communication technology in their teaching methods. This covers how often they use ICT, what tools and resources they utilize, and how well they apply them to support learning. High levels of ICT application frequently include the use of interactive simulations, virtual experiments, digital presentations, and online collaborative tools in instruction. These resources help teachers explain intricate physics ideas more effectively, thus enhancing student understanding and engagement (Olabode, 2021). On the other hand, minimal ICT use, often stemming from limited access, insufficient training, or negative beliefs, can impede the potential advantages of using technology in education.

The degree to which ICT is utilized in teaching can differ among educational institutions and is determined by various factors, such as the availability of technological resources, school policies, and the skill levels of teachers (Adejumo & Salami, 2020). Schools equipped with modern computer labs, reliable Internet access, and multimedia resources typically see higher levels of ICT adoption. In contrast, institutions lacking these facilities often face difficulties in effectively incorporating ICT into their teaching, leading to unequal learning experiences for students.

The use of ICT in education has been proven to boost both student engagement and motivation (Eze & Nwankwo, 2020). Platforms that encourage interactive learning, like digital whiteboards, educational applications, and online forums, allow students to actively participate and work together. Such tools foster lively learning settings where students can grasp complex scientific ideas, conduct virtual experiments, and get immediate feedback on their performance. Nonetheless, limited availability of essential ICT tools for using social media in schools is a significant challenge that affects the involvement of both teachers and students. Many might not be fully aware of how learning strategies influence their educational experience (Okwilagwe & Jinadu, 2023). Furthermore, utilizing ICT supports personalized teaching, enabling educators to adapt lessons to fit the learning styles and speeds of their students. Online learning platforms offer tailored experiences where learners can find extra materials, revisit recorded sessions, and engage in

problem solving using simulations (Adewale & Olatunji, 2021). This customized method improves educational results by addressing the varying needs and preferences of students. When used, these platforms make education more engaging, accessible, and interesting. They are particularly useful for providing education during emergencies, such as the COVID-19 pandemic, and can include communication tools like Skype, chat rooms, Zoom, WhatsApp, Telegram, video conferencing, and webinars (Jinadu, Oyaremi, & Rufai, 2021).

Additionally, using ICT broadens access to a wide range of educational materials that go beyond conventional textbooks. Online resources, academic journals, and open educational resources (OERs) equip teachers and students with the latest information on many subjects, including physics (Ajayi, 2020). This access to extensive knowledge strengthens critical thinking, research abilities, and a thorough grasp of scientific concepts. The connection between educators' attitudes, ICT use, and student performance is crucial for achieving positive learning outcomes. Teachers who view ICT positively and incorporate it well in their lessons can create enriched educational experiences, helping students overcome difficulties in understanding physics. ICT tools, such as digital simulations, virtual labs, interactive models, and multimedia presentations, allow students to visualize and engage with physics concepts in ways that standard teaching may not provide. By using these resources, instructors can make lessons more engaging and accessible, accommodating various learning styles and cognitive capabilities. This approach not only enhances understanding but also increases students' confidence and motivation to study physics.

The role of physics education in promoting advancements in science and technology is very significant. Nonetheless, the academic achievements of students in physics remain a significant issue in secondary schools across Nigeria. Various factors are responsible for this challenge, such as the challenging nature of physics ideas, poor teaching strategies, and insufficient learning materials. Recently, information and communication technology (ICT) has been identified as a valuable resource to improve teaching and learning through interactive simulations, virtual experiments, and multimedia tools. The attitudes of teachers towards ICT and their usage are important factors that can predict how well students perform in physics. Some past research has focused broadly on ICT, while others have looked at teachers' attitudes in a way that does not relate to ICT. This study, therefore, examined how teachers' attitudes and their use of ICT affect students' performance in physics specifically in the Ibadan North local government area.

LITERATURE REVIEW

Technology Acceptance Model (TAM)

The Technology Acceptance Model, which Davis presented in 1989, offers a comprehensive framework to understand what drives people to accept and utilize technology. It highlights two main factors: the perceived ease of use and perceived usefulness. Perceived ease of use is how effortless someone believes using a particular technology will be, while perceived usefulness pertains to how much the technology improves their performance. In an educational setting, these factors play a vital role in influencing how teachers view and use ICT tools in their teaching methods. According to TAM, teachers are more inclined to use ICT tools that they find simple and user friendly. Likewise, if educators see ICT as supportive in meeting educational goals, such as clarifying difficult concepts or enhancing student involvement, the chance of them using these tools in their teaching rises. This model is especially important in physics education, where abstract ideas like wave mechanics, electromagnetism, and quantum theory can be tough for students to grasp. ICT resources, such as simulations, animations, and virtual laboratories, offer visual and interactive experiences that lower cognitive load and promote better understanding, in line with the principles of TAM.

Recent research supports the significance of TAM in educational settings. For example, Adeyemi & Adebayo (2022) studied ICT adoption among secondary school teachers in Nigeria and found that the perceived ease of use significantly predicted technology integration. Educators who considered ICT tools easy to use felt more confident in crafting lesson plans that featured simulations and multimedia presentations. Similarly, Adekunle & Omotayo (2021) used TAM to examine ICT usage in physics classrooms in Ibadan, reaching the conclusion that perceived usefulness greatly affected teachers' willingness to embrace technology. Teachers acknowledging ICT's role in boosting student engagement and academic performance were more inclined to regularly include these tools in their lessons. The applications of TAM go beyond just initial adoption; they also apply to continued and efficient use of ICT tools. Schools that focus on training programs for teachers to improve the ease of use of ICT tools have seen greater levels of technology integration. For instance, Adekunle & Bamidele (2022) showed that workshops centered around the practical advantages of ICT, like using virtual labs for experiments or animations for explaining thermodynamic concepts, boosted teachers' confidence and skills. These results emphasize the necessity of providing practical training tailored to the unique needs of physics education, allowing teachers to tackle challenges related to technical difficulties and unfamiliarity.

Furthermore, TAM highlights the importance of institutional support in encouraging favorable views on ICT adoption. Schools equipped with solid infrastructure, like dependable Internet, updated devices, and access to educational software, foster an environment where teachers can explore technology. According to Ogunleye (2021), the presence of resources significantly shaped teachers' views on the usefulness and ease of use of ICT, especially in rural schools facing infrastructure issues. This indicates the importance for policymakers and stakeholders to tackle systemic obstacles to ICT integration, ensuring that all schools have fair access to resources.

METHOD

Design

The study adopted an ex-post facto design to examine the relationships between variables in a non-manipulated environment. Teachers' attitudes towards ICT and Teachers' ICT usage were the independent variables with students' academic performance in physics as the dependent variable.

Participants and Sample Size

The population for this study consisted of all senior secondary school physics teachers and their students in the Ibadan North Local Government Area, Oyo State, Nigeria. The study employed a multistage sampling technique to select the sample drawn from five public secondary schools comprising of 5 physics teachers and 100 students.

Instrumentation and Data Collection

Three primary instruments were used in this study.

- (i) The Teacher Attitude to ICT Questionnaire (TAIQ) was designed to assess physics teachers' perceptions, beliefs, and attitudes toward Information and Communication Technology (ICT). The instrument is divided into two parts; Section A is on bio data of the teachers, Section B is on attitude towards ICT. The TAIQ used a five-point Likert scale, where teachers were asked to respond on five-point scale of Strongly Disagree (1) to Strongly Agree (5).
- (ii) The Teacher ICT Usage Questionnaire (TIUQ) was developed to assess the extent and frequency of ICT integration in physics instruction. The instrument is also divided

into two sections; section A is on teacher bio data and section B is on ICT usage. Teachers were rated on a five-point scale of Never (1) to Very frequently (5) based on the extent and frequency of use of ICT in teaching.

- (iii) The Physics Achievement Test (PAT) was developed to assess students' academic performance in physics. The instrument is divided into two sections; section A is on the student bio data and section B is with 30 multiple-choice items each carrying one mark, with a total duration of 40 minutes. To ensure validity of the instruments, copies of the instruments were given to psychometricians and Physics teachers to ensure content and construct validity. Copies were also administered on a small sample outside the main sample, and the results were analysed using Cronbach's Alpha and Kuder Richardson_20 which yielded 0.86, 0.78 and 0.83 for TAIQ, TIUQ, and PAT respectively. Informed consent, confidentiality, voluntary participation and data protection of all participants were ensured throughout the study.

Data Analysis

Data collected were analysed through Pearson product moment correlation and multiple regression for testing the hypotheses as follows:

Hypothesis 1: There is no significant relationship between teachers' attitudes toward ICT and students' performance in physics (Pearson product moment correlation).

Hypothesis 2: There is no significant relationship between teacher ICT usage and students' performance in physics (Pearson product moment correlation).

Hypothesis 3: There is no significant joint contribution of teacher attitudes and ICT usage on students' performance in physics (Multiple regression).

Hypothesis 4: There is no significant relative contribution of each of the independent variables (teacher attitudes toward ICT and ICT usage) on students' performance in physics (Multiple regression).

RESULTS

Hypothesis One: There is no significant relationship between teachers' attitudes toward ICT and students' performance in physics.

Table 1: Relationship between Teacher attitude towards ICT and Academic Performance in Physics

Variable	N	X	SD	R	p-value	Remark
Attitude towards ICT	05	56.54	8.018	0.542**	0.000	Sig
Performance in Physics	100	61.89	17.152			

The data in Table 1 shows the relationship between teacher attitudes toward ICT and students' performance in physics. The data revealed that there is a high positive correlation between teacher attitudes toward ICT and students' performance in physics ($r = 0.542$; $P = 0.000$) and it is statistically significant. This indicates that academic performance of students in Physics is significantly influenced by teacher attitude towards ICT.

Hypothesis Two: There is no significant relationship between teacher ICT usage and students' performance in physics.

Table 2: Relationship between Teacher ICT Usage and Performance in Physics

Variable	N	X	SD	R	p-value	Remark
ICT Usage	05	42.03	14.243	0.521*	0.000	Sig
Performance in Physics	100	61.89	17.152			

The data in Table 2 shows the relationship between teacher ICT usage and students' performance in physics. The data revealed that there is a high positive correlation between teacher ICT usage and students' performance in physics ($r = 0.521$; $P = 0.000$) and it is statistically significant. This indicates that academic performance of students in Physics is significantly affected by teacher ICT usage. Meanwhile, high teacher ICT usage will lead to better academic performance in Physics and vice versa.

Hypothesis Three: There is no significant joint contribution of teacher attitudes and ICT usage on students' performance in physics.

The data in Table 3 and Table 4 below show the model summary and regression ANOVA respectively.

Table 3: Model Summary of Predictors on Performance in Physics

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
	.752	.565	.527	14.20615

Table 4: Regression ANOVA of Predictors on Performance in Physics

Model	Sum of Squares	Df	Mean Square	F	Sig
Regression	10012.747	2	5006.374	24.807	0.000**
Residual	20585.100	102	201.815		
Total	30597.848	104			

*Significant at $P < 0.05$ level

The multiple regression correlation coefficient (R) indicates the linear relationship between the independent variables, teacher attitudes towards ICT and teacher ICT usage, and the dependent variable (students' academic performance in Physics) is 0.752. The multiple R^2 is 0.565 which is 56.5% and the Adjusted R square value is 0.527 which is 52.7%. This means that the variation in students' academic performance in Physics accounted for by the independent variables: teacher attitudes towards ICT and teacher ICT usage is approximately 52.7% and it is statistically significant at $p < 0.05$ level. Furthermore, as indicated in Table 4 the Analysis of variance of the multiple regression data produced an F -ratio of $F_{(2,102)} = 24.807$ and was found to be significant at 0.05 Alpha level.

Hypothesis Four: There is no significant relative contribution of each of the independent variables (teacher attitudes toward ICT and ICT usage) on students' performance in physics.

The data in Table 5 shows the contribution of each of the independent variables: teacher attitudes towards ICT and teacher ICT usage, to the prediction of students' academic performance in Physics.

Table 5: Regression Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig
	B	Std. Error	Beta		
(Constant)	6.508	10.903		.597	.552
Attitude towards ICT	.739	.255	.346	2.899	.005**
ICT Usage	.323	.144	.268	2.251	.027**

The two independent variables: teacher attitudes towards ICT and teacher ICT usage contributed significantly to the prediction model at 0.05 level. Attitude towards ICT $\beta = .255$; $t(105) = 2.899$; $p < .05$) contributed most followed by ICT usage $\beta = .144$; $t(105) = 2.251$; $p < .05$).

DISCUSSION

The finding on the relationship between teachers' attitudes toward ICT and students' performance in physics revealed a high positive correlation between teachers' attitudes toward ICT and students' performance in physics, which was statistically significant. This indicates that students' academic performance in physics is significantly influenced by teachers' attitudes toward ICT.

This finding aligns with that of Ajayi (2020) who found that teachers with positive attitudes toward ICT are more likely to integrate it into their teaching, which enhances student performance in complex subjects like physics. The finding also corroborates that of Adebayo (2018), who reported that ICT tools, such as simulations, help students visualize abstract concepts, making them easier to understand and retain.

The result on the relationship between teacher ICT usage and students' performance in physics showed a positive correlation. This suggests that students' academic performance in physics is significantly impacted by the extent to which teachers utilize ICT in their teaching. Higher ICT usage by teachers leads to better student performance, while lower usage results in poorer outcomes. This result is in tune with that of Adebajo & Salisu (2022) who established that high ICT usage improves student academic outcomes, particularly in subjects like physics, where visualizations and simulations enhance conceptual understanding.

The finding with respect to the joint contribution of teacher attitudes towards ICT and ICT usage on students' performance in Physics indicate a linear relationship between the independent variables (teacher attitudes toward ICT and ICT usage) and the dependent variable (students' academic performance in physics). The proportion of variance in students' academic performance explained by these independent variables was found to be high and statistically significant. The analysis of variance (ANOVA) of the multiple regression data produced an F-ratio, which was statistically significant. This finding aligns well with that of Oluwaseun & Ojo (2019) who found out that high ICT usage enabled interactive and visually enriched lessons, leading to improved student comprehension of complex physics concepts. Additionally, the results support Adeyemo & Adeniran (2020), who also found that ICT tools allow for immediate feedback through online quizzes, helping students identify and address areas for improvement.

The result on relative contribution of teacher attitudes towards ICT and ICT usage to students' performance in Physics showed that both variables significantly contributed to prediction of students' performance in Physics with teachers' attitudes toward ICT having the strongest impact, followed by ICT usage. This finding is consistent with that of Adebajo & Salisu (2022) who noted that teachers with positive attitudes toward ICT are more likely to use it effectively, resulting in improved student learning outcomes. The research further reports that students taught by such

teachers tend to perform better in physics, as ICT tools make abstract concepts more accessible and engaging. The result of this study also aligns with that of Yusuf & Balogun (2021), who found that videos and virtual labs enhance physics lessons, increasing student motivation and engagement.

Implications for Practice

The findings of this study suggest some implications for practice. Developers of the ICT facilities must create accessible, straight-forward, and easy-to-use facilities to the extent that even teachers who are skeptical to adopt ICT will have no choice than to use ICT in their teaching. Also, government as employers of teachers, can make the ICT tools available to schools and districts in order to address the issue of access that can hinder usage of ICT for teaching physics and other school subjects. Administrative support, preparation plans, and educators conforming to school norms for using the electronic education system in the instruction process, can all help to bring about these improvements. The school administrators must encourage teachers to adopt ICT for the common good of academic performance and the school.

Limitations and Future Study

This study had some limitations. The study was conducted among selected physics secondary school students in Ibadan thereby limiting the generalisability to physics students and Ibadan. Also, student academic achievement was a product of a single physics achievement test administered on the participants, and performance of students in physics when taken cumulatively over time may yield a different result. Therefore, this type of a study should be on-going and can be replicated in another part of the state or more areas to see improvement in student academic achievement in physics as well as other science subjects.

CONCLUSION

From the study findings it can be concluded that physics teachers' attitudes toward ICT and their level of ICT usage significantly affect students' performance in physics. Teachers with a positive attitude toward ICT were more likely to integrate ICT into their teaching, leading to improved student engagement, comprehension, and ultimately better academic performance in Physics. Therefore, it is recommended that government and educational agencies provide regular ICT training and workshops for physics teachers to improve their confidence and competence in using ICT tools effectively. Also, schools should be equipped with adequate ICT facilities, including interactive whiteboards, projectors, and physics simulation software, to encourage teachers to use ICT in their lessons. And teachers should be encouraged to integrate ICT into their daily lesson plans through incentives, professional development programs, and mentorship opportunities.

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