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Enhancing Physics Education in Nigerian Secondary Schools: Exploring Innovative Teaching Strategies to Improve Student Engagement and Academic Performance

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Abstract

Student engagement and academic performance are critical indicators of educational success. Findings from this study revealed that students exposed to innovative teaching strategies demonstrated significantly higher engagement and achievement than those taught using traditional methods. The mean engagement score of students in the experimental group was M = 3.82, SD = 0.47, compared with M = 2.91, SD = 0.52 for the control group. Similarly, academic performance improved notably, with the experimental group recording a higher mean test score (M= 68.45, SD = 7.36) than the control group (M = 54.20, SD = 8.14). These improvements are attributed to the use of active learning techniques, technology integration, collaborative learning, and personalized instruction. Interactive approaches such as project-based learning and flipped classrooms enhanced student–teacher interaction, real-world application of concepts, and continuous assessment, thereby sustaining motivation and promoting higher academic achievement.

Keywords: *Innovative Learning Strategies; Student Engagement; Academic Performance; Active Learning; Digital Tools; Educational Success.*

INTRODUCTION

Physics, as a core science subject, plays a crucial role in fostering scientific literacy and technological advancement, as it provides learners with fundamental knowledge and problem-solving skills essential for national development (Adeyemo, 2010; UNESCO, 2017). In Nigeria, secondary school physics education continues to face persistent challenges, including inadequate teaching methods, low student engagement, and poor academic performance (Aina & Akintunde, 2013; WAEC, 2020). These challenges are further compounded by the heavy reliance on traditional, teacher-centered instructional approaches, which often fail to stimulate students' interest or promote deep conceptual understanding of physics concepts (Adesoji & Olatunbosun, 2008; Omosewo, 2009).

Moreover, the persistent challenges in physics education in Nigerian secondary schools have been widely documented. Studies such as Okebukola (2002), and Ezeliora & Ogbonna (2010) identify traditional, lecture-based instructional methods as a major factor contributing to students' lack of interest and poor academic performance in physics. These teacher-centered strategies often limit students' active participation and critical thinking, resulting in surface-level understanding of key physics concepts.

In response various scholars have proposed and tested innovative instructional strategies aimed at improving engagement and learning outcomes. Inquiry-Based Learning (IBL), for instance, has gained recognition for promoting curiosity, problem-solving, and deeper conceptual understanding (Achor, Imoko & Uloko, 2009). Similarly, the use of simulations and virtual laboratories has been shown to enhance visualization of abstract concepts and foster interactive learning (Yusuf & Afolabi, 2010).Furthermore, the importance of improving physics education cannot be overstated. With Nigeria's growing emphasis on science, technology, engineering, and mathematics (STEM) education, there is a pressing need to explore innovative teaching strategies that are both contextually relevant and pedagogically effective. This research investigates

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the integration of innovative teaching approaches—such as inquiry-based learning, collaborative learning, use of simulations, and interactive technologies in Nigerian secondary schools to enhance student engagement and improve academic outcomes.

Hence, collaborative learning approaches, such as peer instruction and group problem-solving, have also been highlighted for their potential to enhance student motivation and performance (Jegede, 2007). Furthermore, technology enhanced strategies like flipped classrooms and educational games are gaining attention, though their implementation in Nigerian classrooms remains limited due to infrastructural and training constraints (Adewale & Bello, 2018).

The context of existing challenges and emerging pedagogical trends, this paper aims to contribute to the discourse on effective physics instruction in Nigeria. It seeks to provide empirical insights that inform policy, guide teacher training, and foster a more engaging and effective learning environment for secondary school students. Despite these promising developments, a gap exists in the comprehensive adoption and contextual evaluation of these methods within Nigerian secondary schools. Few studies provide empirical evidence on the direct impact of innovative strategies on both student engagement and academic performance, especially in physics. This research seeks to address this gap by exploring how a combination of innovative teaching methods can be effectively integrated into Nigerian classrooms to produce measurable improvements.

METHODOLOGY

Research Design

This study adopts a mixed-methods research design, combining both quantitative and qualitative approaches to provide a comprehensive analysis of the effectiveness of innovative teaching strategies in enhancing student engagement and academic performance in physics. This design allows for triangulation of data, enhancing the validity and depth of the findings.

Population and Sample

The target population comprises senior secondary school physics students and their teachers across selected public schools in Kano state of Nigeria. A purposive sampling technique was used to select six secondary schools with a history of consistent participation in physics instruction and examinations. From these schools, a sample of 180 students (30 per school) and 12 physics teachers (2 per school) participated in the study.

Instruments for Data Collection

Data were collected using the following instruments:

Student Engagement Questionnaire (SEQ): A structured instrument measuring cognitive, behavioral, and emotional engagement.

Physics Achievement Test (PAT): A standardized test developed to assess students' academic performance in physics.

Teacher Interview Guide: A semi-structured guide used to gather insights from teachers regarding their experiences with innovative teaching strategies.

Classroom Observation Checklist: Used to document the implementation of various teaching strategies and student responses during lessons.

Procedure

The study was conducted in three phases:

Pre-intervention Phase: Baseline data on student engagement and academic performance were collected.

Intervention Phase: Teachers were trained to implement selected innovative teaching strategies including inquiry-based learning, collaborative group work, and use of simulations and multimedia tools over an 8-week period.

Post-intervention Phase: Student engagement and academic performance were reassessed using the same instruments.

Data Analysis

Quantitative data from the SEQ and PAT were analyzed using descriptive and inferential statistics, including paired sample t-tests and ANOVA to compare pre- and post-intervention scores. Qualitative data from interviews and observations were transcribed, coded, and analyzed thematically to identify patterns and contextual factors influencing the success of the strategies.

RESULTS

The results of this study are presented in two main categories: students' academic performance and their level of engagement in physics learning before and after the implementation of innovative teaching strategies.

Academic Performance

Table 1 shows the mean scores of students on the Physics Achievement Test (PAT) before and after the intervention.

Table 1. Pre-test and Post-test Mean Scores on Physics Achievement Test

Group	N	Pre-test mean	Post – test mean	Mean difference	t-value	p-value
Experimental	180	42.3	65.7	23.4	9.81	0.000

*Significant at $p < 0.05$

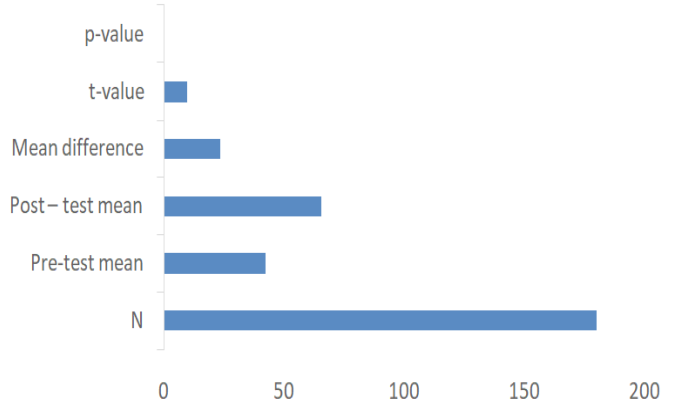

Figure 1. Mean Scores on Physics Achievement Test

The result indicates a statistically significant improvement in students' academic performance after the intervention, suggesting that the use of innovative teaching strategies had a positive effect on learning outcomes.

Student Engagement

Student engagement was measured across three dimensions: behavioral, emotional, and cognitive. Table 2 and fig. 2, summarizes the changes in engagement levels.

Table 2. Changes in Student Engagement Scores

Engagement dimension	Pre-test mean	Post – test mean	Difference
Behavioral	3.1	4.2	+1.1
Emotional	2.9	4.0	+1.1
Cognitive	3.0	4.3	+1.3

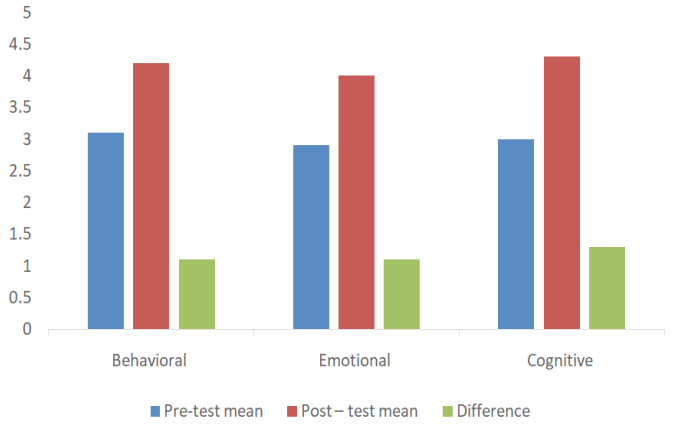

Figure 2. Student Engagement Scores

The data reveal increased engagement in all three dimensions following the intervention. Observations and interviews with teachers supported these findings, noting higher levels of student participation, interest, and enthusiasm during lessons.

Qualitative Insights

Themes from the teacher interviews and classroom observations included:

- Increased student curiosity and collaboration
- Improved classroom interaction and reduced boredom
- Greater ease in explaining abstract concepts using simulations

Teachers reported that the innovative methods were more demanding in terms of planning but yielded better student outcomes and satisfaction.

DISCUSSION

The results of this study provide compelling evidence that the implementation of innovative teaching strategies can significantly enhance both student engagement and academic performance in secondary school physics in Nigeria. The notable improvement in Physics Achievement Test scores suggests that students benefit academically from active and interactive learning environments. This finding aligns with previous studies (Achor et al, 2009; Yusuf & Afolabi, 2010) which assert that inquiry-based and technology-enhanced strategies foster deeper understanding of scientific concepts.

Moreover, the observed increase in behavioral, emotional, and cognitive engagement confirms the effectiveness of these strategies in stimulating student interest and participation. This supports the work of Jegede (2007), who found that collaborative learning methods foster greater involvement and motivation among students. The qualitative insights further reinforce this conclusion, with teachers reporting enhanced student enthusiasm and more dynamic classroom interactions.

A key implication of this research is the potential of innovative strategies particularly inquiry-based learning, simulations, and group work to transform the traditional physics classroom into a more engaging and effective learning space. However, challenges such as limited access to digital tools and the need for teacher training remain significant barriers to widespread implementation. Addressing these constraints is essential for scaling and sustaining the benefits observed in this study.

The findings also suggest that educational stakeholders, including curriculum planners and school administrators, should prioritize the integration of these strategies into teacher professional development programs. Additionally, policy frameworks should support resource allocation for technology and instructional materials that facilitate innovation in physics teaching.

CONCLUSION

This study examined the impact of innovative teaching strategies on student engagement and academic performance in physics within Nigerian secondary schools. The findings demonstrated that the integration of approaches such as inquiry-based learning, collaborative activities, and

technology-enhanced instruction significantly improved both students' interest in physics and their academic outcomes.The results underscore the need for a pedagogical shift from traditional, teacher-centered methods to more student-centered and interactive strategies. While the study confirms the effectiveness of these innovations, it also highlights challenges related to inadequate resources and limited teacher preparedness, which must be addressed to achieve broader implementation.

Limitations of the study include the relatively small sample size and the focus on only a few schools, which may limit the generalizability of the findings. Furthermore, the duration of the intervention was relatively short, and long-term impacts were not assessed. Future research should explore the longitudinal effects of innovative teaching strategies, investigate their applicability across different regions and subjects, and examine how professional development can effectively support teachers in adopting these methods.

By contributing empirical evidence on effective teaching practices, this study offers valuable insights for educators, policymakers, and researchers aiming to revitalize physics education in Nigeria and foster a generation of scientifically literate and motivated learners.

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