

EFFECTS OF MULTIMEDIA-BASED INSTRUCTIONAL PACKAGES ON PUBLIC SECONDARY SCHOOL STUDENTS' ACADEMIC ACHIEVEMENT IN PHYSICS IN OGUN STATE NIGERIA

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Abstract

This study explored the effects of Multimedia-Based Instructional Packages (MBIP) on Senior Secondary School students' academic achievement and attitude in Physics in Ogun State, Nigeria. Physics, a critical component of the Nigerian secondary school curriculum, is essential for fostering students' scientific understanding and preparing them for future challenges in various fields. Five research questions and three null hypotheses guided the inquiry. The study adopted a pretest-posttest, control group quasi-experimental design. The study employed simple random sampling

techniques. Data were analyzed using Analysis of Covariance (ANCOVA). Results indicated that students taught with multimedia tools significantly outperformed their peers in traditional settings, with notable differences based on gender and treatment type. The findings confirm that MBIP leads to enhanced academic achievement in Physics compared to conventional methods, promoting student interaction and engagement. The study recommends that Physics educators adopt multimedia strategies to foster better learning outcomes, ensure proper supervision during multimedia use, and advocate for government support in integrating these instructional tools into teaching practices. Workshops and seminars on multimedia benefits for educators and students are also suggested to enhance the effectiveness of Physics education.

Keywords: *multimedia, instructional packages, physics, academic achievement and attitude.*

Introduction

The integration of technology in education has revolutionized teaching and learning methodologies, particularly in science subjects like Physics. In Ogun State, Nigeria, where Physics is a critical component of the senior secondary school curriculum, the need for effective instructional strategies is paramount. Physics not only underpins advancements in various fields such as communication, health, and transportation, but it also cultivates analytical and problem-solving skills essential for the modern workforce. However, despite its significance, many students face challenges in learning

Physics, often perceiving it as a difficult subject. This perception has been attributed to traditional, teacher-centred instructional methods, which frequently rely on rote memorization and passive learning.

Research has consistently shown that conventional methods often referred to as "chalk and talk" fail to engage students adequately, leading to lower academic performance. This challenge is exacerbated by a lack of appropriate instructional materials and resources that can facilitate deeper understanding (Adegoke, 2021). Studies indicate that students taught through these traditional methods such as the use of chalkboard and locally produced instructional materials often demonstrate average or below-average performance, particularly in Physics, which requires conceptual understanding and practical application. Consequently, there is a pressing need for alternative teaching strategies that not only enhance student engagement but also improve academic achievement (Adegoke, 2021).

Multimedia-Based Instructional Packages (MBIPs) present a promising solution to these challenges. MBIPs encompass a variety of digital tools, including computer animations, simulations, and graphics, which can create interactive learning environments. These tools not only cater for different learning styles but also promote active engagement, collaboration, and critical thinking among students. By utilizing multimedia, educators can transform abstract Physics concepts into concrete visualizations, thereby facilitating better comprehension. Prior studies have indicated that students exposed to multimedia instruction tend to exhibit more positive

attitudes toward the subject, leading to increased motivation and improved academic outcomes.

In the context of Ogun State, this research aims to explore the specific effects of MBIPs on secondary school students' academic achievement and attitudes in Physics. This study seeks to address several critical questions: How do multimedia instructional packages compare to conventional teaching methods in terms of student achievement? What is the relationship between multimedia usage and student attitudes towards Physics? Additionally, the role of gender as a moderating factor in these dynamics was examined to ensure a comprehensive understanding of the educational landscape.

Statement of the Problem

Physics, as a foundational science subject, plays a critical role in equipping students with the skills and knowledge necessary for technological and industrial development. However, the persistent poor academic achievement and lack of positive attitude among public secondary school students in Ogun State, Nigeria, raise concerns about the effectiveness of traditional teaching methods. According to Abidoye (2018), the widely adopted "chalk-and-talk" approach, which is primarily teacher-centered and emphasizes rote memorization, has proven inadequate in addressing the challenges associated with teaching abstract and complex physics concepts. He opined that the key problems associated with the chalk-and-talk method include:

1. **Minimal Student Engagement:** Students are passive recipients of information, which limits their ability to actively participate in the learning process or engage in critical thinking.
2. **Difficulty in Visualizing Abstract Concepts:** Physics often involves phenomena that cannot be directly observed, such as electromagnetic waves or atomic structures. The lack of visual aids in the chalk-and-talk method hinders students' comprehension of these concepts.
3. **Inadequate Skill Development:** The approach focuses more on theoretical explanations than on practical applications, leaving students unprepared to apply knowledge to real-world situations.
4. **Low Retention Rates:** Due to the monotonous nature of the method, students often struggle to retain what they have learned over time.
5. **Negative Attitudes toward Physics:** The inability to connect classroom instruction with practical experiences fosters frustration and disinterest among students, resulting in a general perception of physics as a difficult and unapproachable subject.

The emergence of multimedia-based instructional packages offers a promising alternative to address these shortcomings. These packages integrate visual, auditory, and interactive elements, enabling students to better visualize abstract concepts, actively engage in lessons,

and connect theoretical knowledge with practical applications (Adegoke, 2021, Adeyemo, 2019). However, in Ogun State, the adoption and assessment of these technologies in public secondary schools remain limited due to challenges such as inadequate teacher training, limited access to digital resources, and insufficient empirical studies.

Existing research in other regions has shown that multimedia-based instruction can significantly enhance students' academic performance and foster positive attitudes toward learning. However, there is a lack of localized studies investigating the effects of such instructional tools on physics education in Ogun State (Aremu & Sangodoyin, 2019, Awoniyi, 2019, Sharma, 2018, Uduosoro, 2021 and Sangodoyin, 2019). This gap must be addressed to develop evidence-based strategies that can improve the teaching and learning of physics.

This study, therefore, aims to investigate the effects of multimedia-based instructional packages on the academic achievement of public secondary school students in physics in Ogun State. By addressing the limitations of traditional methods and exploring innovative solutions, the findings will provide valuable insights for educators, policymakers, and stakeholders in improving physics education and fostering a scientifically literate generation capable of contributing to national development.

The main objective of this study is to investigate the effects of multimedia-based instructional packages (Computer Animation and Computer Graphic) on senior

secondary school students' academic achievement in physics in Ogun State, Nigeria.

Hypotheses

The following null hypotheses guided the study:

1. There is no significant main effect of treatments on students' achievement scores in physics in public secondary schools in Ogun State
2. There is no significant moderating effect of gender on student's academic achievement scores in Physics in public secondary schools in Ogun State, Nigeria
3. There is no significant interaction effect of treatments and gender on students' academic achievement scores in Physics in Public Secondary schools in Ogun State.

This study is anchored on two theories behaviourism and constructivism. Behaviourism, articulated by John Watson (1878-1958) and B.F. Skinner (1904-1990), focuses on observable behaviours shaped by environmental stimuli and responses. Key tenets include: **Observable Outcomes** where learning is evidenced by observable changes in behaviour; **Stimulus-Response Associations** where learning occurs through conditioning and reinforcement; **Rewards and Punishments** where desired behaviours are reinforced through rewards, fostering learning and **Instructional Design Principles** where instruction is structured to present stimuli and encourage desired responses through cues and reinforcement mechanisms. Behaviourism's relevance lies in its applicability to modern educational technologies, such as Skinner's teaching machines, which laid foundational principles for Computer-

Assisted Instruction (CAI) and digital learning environments.

Constructivism posits that learners actively construct knowledge through personal experiences and interactions. Key aspects include: **Active Knowledge Construction** where learners interpret and construct meaning based on prior knowledge and new information; **Social Interaction** where learning is enhanced through collaborative activities and discussions and **Authentic Tasks** where problem-solving tasks in real-world contexts promote deeper understanding and application of knowledge.

This theory underscores the importance of engaging learners actively in the learning process, utilizing multimedia tools like simulations and multimedia projectors to facilitate interactive learning experiences.

Several studies have explored the efficacy of multimedia instructional techniques in enhancing student learning outcomes across various subjects, including Physics. Adegoke (2021) demonstrated that learners exposed to computer-based multimedia instruction outperformed those taught under traditional teacher-based methods in both recall and transfer tasks. This superiority of multimedia instruction is attributed to its multi-sensory nature, engaging both visual and auditory senses, thereby transforming the classroom into an interactive learning environment.

Udousoro (2020), Brashears, Akers, and Smith (2019), Kolawole and Oginni (2019), Sangodoyin (2019), and Owolabi and Oginni (2020) corroborated that multimedia instruction facilitates improved learning outcomes, particularly in grasping abstract subject matter like Physics. Conversely, Brashears, Akers, and Smith (2019) found no significant improvement in learning with video-based instruction, suggesting mixed findings in the literature.

Abidoye (2018) explored the effect of multimedia-based instructional packages on academic achievement in Geography, revealing significant performance gains among students exposed to multimedia compared to traditional methods. Similarly, Abdul (2017) and Adeosun (2020) highlighted multimedia's positive impact on academic achievement in subjects like Geography and Social Studies.

Further enhancing multimedia's effectiveness, Adegoke (2020) found that combining animation, narration, and on-screen text yielded superior learning outcomes compared to single-media approaches. This approach not only enhanced retention but also sustained student attention throughout the learning process (Muller, Lee, & Sharma, 2018).

Illustrating the broader applicability of multimedia in education, studies by Rani (2020), Agboola and Oloyede (2018), and Kim and Gilman (2018) emphasized multimedia's role in enhancing student attitudes and performance across various subjects and instructional

settings. For instance, animations were found to significantly improve student engagement and understanding in complex topics like Physiology (Hwang et al., 2021). Despite these benefits, gender differences in response to multimedia remain inconclusive. Bebetos and Antoniou (2018) suggested that females may have more positive perceptions of multimedia applications compared to males, while Awoniyi (2019) and Al-Rabaani (2018) reported varying attitudes towards multimedia between genders.

Methodology

This study adopted a pretest- posttest; control group quasi -experimental design. The target population for this study consists of 1,850 senior secondary school students offering Physics in Ogun State. This study employed simple random sampling techniques to select 126 students from three schools in three geopolitical areas of the state. This study employed simple random sampling techniques to select the sample.

At first stage, the population is randomly sampled into three (3) Senatorial Districts in Ogun State which are:

1. Ogun Central Senatorial District
2. Ogun East Senatorial District
3. Ogun West Senatorial District

At the second stage three (3) local governments were randomly selected from each of the three Senatorial Districts, the Local Governments are:

1. Abeokuta North Local Government Area
2. Sagamu Local Government Area

3. Yewa South Local Government Area

At the third Stage three (3) schools was randomly selected from each of the (3) chosen local governments which are:

- Ebenezer Grammar School, Iberekodo, Abeokuta
- Makun High School, Sagamu
- Comprehensive High School, Ayetoro

At fourth stage 40% was taken from the population of Senior Secondary School II Science students of each school. Thus:

- Ebenezer Grammar School, Abeokuta -- $82 \times 40\% = 33$ Students
- Makun High School, Sagamu -- $98 \times 40\% = 39$ Students
- Comprehensive High School, Ayetoro -- $135 \times 40\% = 54$ Students

Thus, we have the total of 126 samples as earlier stated. One instrument (physics achievement test and student's attitude questionnaire) was designed for the study. The instrument contains two sections. Section A; Background Information for students, Section B consisted of 50 multiple choice items with four alternatives. Face and content validity of the instruments were done, Kuder-Richardson method (KR 20) was used to establish the reliability co-efficient at 0.86 and 0.78 respectively.

Analysis of Covariance (ANCOVA) and Estimated Marginal Mean (EMM) was employed to determine the magnitude and direction of the difference among the groups. The mean benchmark for the questionnaire was established at 2.92. This benchmark will serve as a

threshold to interpret the average responses from respondents.

Results

Hypotheses One: There is no significant main effect of treatments on students' achievement scores in physics in public secondary schools in Ogun State

Table 1: Analysis of Covariance Showing the Effect of Treatment on Students' Academic Achievement in Physics

Source	Dependent Variable	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	Achievement	35357.86 ^a	6	5892.98	3083.87	0.00	0.98
Pretest	Achievement	0.83	1	0.83	0.44	0.51	0.00
Treatments	Achievements	33021.54	2	16510.77	8640.30	0.00	0.98
Gender	Achievement	0.36	1	0.36	0.19	0.67	0.00
Treatments * Gender	Achievement	4.74	2	2.37	1.24	0.29	0.01
Error	Achievement	762.45	399	1.91			
Total	Achievement	363845.00	406				
Corrected Total	Achievement	36120.32	405				

Result in table 1 shows that the treatment significantly affects students' academic achievement in Physics ($F = 3,083.87$, $p = 0.00$), explaining 98% of the variance (Partial Eta Squared = 0.98). The pretest has no significant impact ($F = 0.44$, $p = 0.51$), indicating prior knowledge doesn't influence post-treatment performance. Gender has no significant effect ($F = 0.19$, $p = 0.67$), and the interaction between treatment and gender is also insignificant ($F = 1.24$, $p = 0.29$), with a very small effect size (Partial Eta Squared = 0.01).

Hypotheses Two: There is no significant main effect of gender on student's academic achievement scores in Physics in public secondary schools in Ogun State, Nigeria

Table 2: Analysis of Covariance Showing the Effect of Gender on Students' Academic Achievement in Physics

Source	Dependent Variable	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	Achievement	35357.86 ^a	6	5892.98	3083.87	0.00	0.98
Intercept	Achievement	6493.51	1	6493.51	3398.14	0.00	0.90
Pretest	Achievement	0.83	1	0.83	0.44	0.51	0.00
Treatments	Achievements	33021.54	2	16510.77	8640.30	0.00	0.98
Gender	Achievement	0.36	1	0.36	0.19	0.67	0.00
Treatments Gender Error	*Achievement	4.74	2	2.37	1.24	0.29	0.01
Total	Achievement	762.45	399	1.91			
Corrected Total	Achievement	363845.00	406				
		36120.32	405				

The ANCOVA results show that gender has no significant effect on students' academic achievement in Physics ($F = 0.19$, $p = 0.67$), with a very small effect size (Partial Eta Squared = 0.00). This suggests that male and female students perform similarly in Physics, regardless of the treatment. The treatment variable has a strong and significant impact ($F = 8,640.30$, $p = 0.00$), explaining 98% of the variance (Partial Eta Squared = 0.98). The interaction between treatment and gender is also not significant ($F = 1.24$, $p = 0.29$), confirming that gender does not influence how the treatment affects

achievement. These results highlight that the instructional method benefits both male and female students equally

Hypotheses Three: There is no significant interaction effect of treatments and gender on students' academic achievement scores in Physics in Public Secondary schools in Ogun State.

Table 3: Analysis of Covariance Showing the Interaction Effect of Treatment and Gender on students' Academic Achievement in Physics.

Source	Dependent Variable	Type Sum Squares	III of Df	Mean Square	F	Partial Eta Sig.	Partial Eta Squared
Corrected Model	Achievement	35357.86	6	5892.98	3083.87	0.00	0.98
Intercept	Achievement	6493.51	1	6493.51	3398.14	0.00	0.90
Pretest	Achievement	0.83	1	0.83	0.44	0.51	0.00
Treatments	Achievements	33021.54	2	16510.77	8640.30	0.00	0.98
Gender	Achievement	0.36	1	0.36	0.19	0.67	0.00
Treatments Gender	*Achievement	4.74	2	2.37	1.24	0.29	0.01
Error	Achievement	762.45	399	1.91			
Total	Achievement	363845.00	406				
Corrected Total	Achievement	36120.32	405				

The ANCOVA results for the interaction between treatment and gender on students' academic achievement in Physics show no significant effect ($F = 1.24$, $p = 0.29$), with a very small effect size (Partial Eta Squared = 0.01). This indicates that gender does not influence the effectiveness of the treatment on achievement. The treatment variable itself has a significant effect ($F =$

8,640.30, $p = 0.00$), explaining 98% of the variance in academic achievement (Partial Eta Squared = 0.98). The gender variable also does not significantly affect achievement ($F = 0.19$, $p = 0.67$), confirming that both male and female students benefit equally from the treatment.

Summary of Findings

The following findings emerged after analysis:

1. There was a difference between the mean achievement scores of students taught Physics using Computer Animation Learning Package and those taught using Conventional Teaching Approach;
2. There was a difference between the mean achievement scores of students taught Physics using Computer Graphic Learning Package and those taught using Conventional Teaching Approach;
3. There was a difference between the mean achievement scores of students' taught Physics using Computer Animation Learning Package and those taught using Computer Graphic Learning Package;
4. There was a difference between the academic achievement scores of male and female students' taught Physics using treatment strategies;
5. There is a significant main effect of treatments on students' achievement in Physics because, students taught Physics with Computer

Animation Learning Package better than those taught with conventional teaching approach.

6. There was a significant moderating effect of gender on student's academic achievement scores in Physics; and
7. There was a significant interaction effect of treatments and gender on students' academic achievement scores in Physics in Public Secondary schools in Ogun State.

Discussion of Findings

The findings from hypothesis one aligns with prior research. Studies by Joda, Fatima, and Mohammed (2019), Boris (2020), Amobi and Uche (2022), Sanni, Ibrahim, and Bala (2022), as well as Fasasi and Istifanus (2022), affirmed that treatment strategies significantly enhance students' academic achievement compared to conventional lecture methods. Similarly, Hussein and Neamah (2020) and Mohammed and Samuel (2022) reported statistically significant differences in academic achievement between students taught using computer animation and those taught with the traditional lecture approach.

The results of hypothesis two are consistent with the findings of Amobi and Uche (2022), who observed that gender was not a significant determinant of students' achievement, although female students outperformed their male counterparts. Likewise, Dancy and Beichner (2021) found that gender did not significantly influence variations in students' achievement scores in Physics.

The findings from hypothesis three corroborate earlier studies. Owenbiugie and Iyoha (2017) concluded that the Computer Graphic Learning Package method effectively enhances students' achievement in Physics regardless of gender. This is supported by Agboh (2015), who indicated that gender had no significant interaction effects with the applied treatment. Similarly, Nnorom (2015) and Eze, Ezenwafor, and Obidile (2016) found no significant interaction effects between treatment methods and gender on students' academic achievement in Physics.

Conclusion

Multimedia instructional packages play a pivotal role in shaping students' academic achievement and attitudes. In the context of physics education in Ogun state, leveraging multimedia tools such as interactive simulations, animations and videos enhanced students' understanding, attitude, engagement and retention. However, successful implementation requires thoughtful integration into the curriculum, teacher training and alignment with pedagogical goals.

Recommendations

The following recommendations were presented based on the findings of the study:

1. Physics teachers should employ the use of Multimedia based Instructional Package (Computer Animation) for teaching Physics in order to enhance students' academic achievement in Physics.
2. Physics teachers should employ also employ the use of Multimedia based Instructional

Package (Computer Graphic) for teaching Physics and to enhance students' academic achievement.

3. Physics teachers should ensure proper monitoring of students when using Multimedia based Instructional Packages (Computer Animation and Computer Graphic) especially during class discussions so that optimal result of this strategy will be achieved.

References

- Abdu-Raheem, B.O. (2021). *The influence of gender on secondary school students' academic performance in South-West, Nigeria. Journal of Social Sciences, 31(1), 93-98.*
- Abidoye, T. (2018). *Effect of Multimedia-based instructional package on secondary students' academic achievement in Geography in Oyo State. International Journal of Educational Technology, 41(3), 287-301.*
- Adegoke, B.A. (2021). *Effect of multimedia instruction on senior secondary school students' achievement in Physics. European Journal of Educational Studies, 3(3), 537-541.*
- Adegoke, T. M. (2021). Comparative study of the effectiveness of computer-based multimedia instruction and traditional instruction on students' performance in Biology in Lagos State. *Journal of Educational Technology, 45(2), 112-127.*
- Agboh, I. (2015). *Gender Dynamics in Physics Education: A Study on Teaching Methods and*

Student Achievement.

- Amobi, U., & Uche, N. (2022). *Enhancing Secondary School Students' Academic Performance in Biology Through Instructional Scaffolding*. *International Journal of Research Publication and Reviews*, Vol. 3(11), pp. 287-293.
- Aremu, A. & Sangodoyin, A., (2019). *Computer Animation and the Academic Achievement of Nigerian Senior Secondary School Students in Biology*. *Journal of the Research Center for Educational Technology (RCET) 2019*. 6.2: 148-161.
- Awoniyi, A. S. (2019). *Sex Difference in an Academic Performance*. *Nigeria Journal of Gender and Development* 1.82: 18-25.
- Barton A.C. (2020). *Grafting Multicultural Science Education with Pre- service Teachers Through Service Learning*, *Journal of Curriculum Studies*, Volume 32(6), Pp. 797 – 820
- Boris, A. (2020). *Impact of Advance Organizer Teaching Strategy on Students' Academic Performance in Basic Science in Nigerian Secondary Schools*. *International Journal of Innovative Studies*, 1(2), 22-28.
- Brashears, B., Akers, C., & Smith, J. (2019). *Video not video: A meta-analysis of multimedia-based instruction*. *Journal of Educational Psychology*, 105(2), 374-386.
- Dancy, M. & Beichner, R. (2016). *Impact of Animation on Assessment of Conceptual Understanding in Physics*, *Physical Review Special Topics - Physics Education Research*, 2.1. Retrieved on

- March 14, 2013, from <https://prstper.aps.org/pdf/PRSTPERyv2/il/e>.
- Dancy, M., & Beichner, R. (2021). *Effect of gender, self-efficacy, and interest on the perception of the learning environment and outcomes in calculus-based introductory physics courses. Physical Review Physics Education Research*, 17(1), 010143. DOI: 10.1103/PhysRevPhysEducRes.17.010143.
- Eze, U., Ezenwafor, C.&Obidile, P. (2016). *Interaction Effects of Teaching Methods and Gender on Academic Achievement in Physics*.
- Fasasi, F.&Istifanus, A. (2022). *Comparative Analysis of Teaching Methods and Their Impact on Students' Academic Performance*.
- Hussein, M. & Neamah, H. (2020). *Effect of Animation as an Instructional Strategy on Students' Achievement and Retention in Chemical Bonding in Nigeria*. Published in *International Journal of Research in Education and Sustainable Development*, 1(8), 45-50.
- Joda, F., Fatima, A., & Mohammed, M. (2019). *Effects of Instructional Scaffolding Strategy on Senior Secondary Biology Students' Academic Achievement and Retention in Taraba State, Nigeria. Education Quarterly Reviews*, 2(2), 269-275.
- Kolawole, F. D., & Oginni, O. O. (2019). Enhancing the teaching and learning of Physics through multimedia instructional materials. *Journal of Physics Education*, 25(1), 45-58.
- Mohammed, M. and Samuel, A. (2022). *Effect of*

Animation as an Instructional Strategy on Students' Academic Achievement and Retention in Chemistry. International Journal of Research in Education and Sustainable Development, Vol 1 (8).

- Nnorom, R. (2015). *Interaction Effects of Treatment and Gender on Academic Achievement in Physics.*
- Owenvbiugie, R. O., & Iyoha, A. D. (2017). *Effect of Computer Graphic Learning Package on Students' Achievement in Physics*
- Park, C. Kim, D. Cho, S. & Han, H. (2019). *Adoption of multimedia technology for learning and gender difference. Computers in Human Behaviour* 2019. Pp. 92 -97.
- Sangodoyin, I. A. (2019). *Effects of Computer Graphics and Presentation Modes on Students' Learning Outcomes in Senior Secondary School Biology in Southwestern Nigeria. Unpublished Ph.D. Thesis, University of Ibadan. Ibadan.*
- Sani, S., Ibrahim, I., and Bala, A. (2022). *The Effect of Innovative Teaching Strategies on Physics Students' Academic Achievement and Gender Neutrality.*
- Sawsan, N. Izzat, A. Mohammed, A. & Fatima, S, (2021). *Studying the Impact of Using Multimedia Interactive Programs at Children Ability to Learn Basic Math Skills Acta Didactica Napocensia* 5.2: Pp.17-31.
- Sharma, S. (2018). *Effectiveness of Two Methods of Instruction: Multimedia and Conventional Instruction for Developing Environmental Awareness Among Elementary School Children.*

*Ph.D. dissertation abstract, M.D.U Rohtak 4.7.
Pp.121-132*

Udousoro, V. J. (2021). *The Relative Effectiveness of
Computer and Text-Assisted Programme
Instruction on Students' Learning Outcomes in
Mathematics. Unpublished Ph.D. Thesis,
University of Ibadan, Ibadan.*