

EFFECT OF USING MULTIMEDIA ON STUDENTS ACADEMIC ACHIEVEMENT IN BASIC SCIENCE IN SECONDARY SCHOOLS OF WUDIL EDUCATION ZONE, KANO STATE, NIGERIA

By

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Abstract

This study investigated the effect of using multimedia on students' academic achievement in Basic Science in secondary schools within Wudil Education Zone, Kano State, Nigeria. The study adopted a quasi-experimental pretest-posttest design involving a population of 4,796 Junior Secondary School students across 26 schools. A sample of 161 students was selected from four schools using stratified random sampling. Two boys' and two girls' schools were chosen; one from each gender served as the experimental group (45 males and 44 females) while the other served as the control group (35 males and 37 females). The instrument used for data collection was the Wudil Basic Science Achievement Test (WBSAT) with a reliability coefficient of 0.82. The experimental groups were taught selected Basic Science topics using multimedia instructional packages (animations, videos, and interactive PowerPoint slides), while the control groups were taught using the conventional lecture method. Three null hypotheses were stated in line with research questions raised. The data collected were analyzed using mean, standard deviation, and independent samples t-test at a 0.05 level of significance. Findings revealed that students taught using multimedia achieved significantly higher mean scores than those taught using the conventional method. Both male and female students in the multimedia groups performed significantly better than their counterparts in the control groups. The study concluded that multimedia instruction enhances students' understanding, engagement, and academic achievement in Basic Science irrespective of gender. It was recommended that Basic Science teachers integrate multimedia technologies into classroom instruction to promote active learning, while education authorities should provide adequate ICT facilities and organize training workshops for teachers on effective multimedia use.

Keywords: Multimedia, Basic Science, Academic Achievement, Quasi-Experimental, Wudil Education Zone.

Introduction

Science as a subject occupies a very important position in school curriculum. It is the tap root system upon which the bulk of present day technological breakthrough is built. All over the globe including Nigeria are striving hard to develop technologically and scientifically, since the world is turning scientific and all the proper functioning of lives depend greatly on

science(Atsuwe, Adeniran & Lortyom, 2019). A society with high level of science and technology would then be regarded as being developed. Science is valued by society because the application of scientific knowledge helps to satisfy many basic human needs and improve living standards. Knowledge derived by science informs societal behaviors and policies. Furthermore, technologies discovered via science can be circular in that they can improve the next round of investigation and can result in better lifestyles for mankind. But how science is incorporated into life by society is sometimes contentious, leading to polarization based on ideology. Although discourse on the use of science is necessary and good, forces of misinformation, disinformation, and outright lies often manifest themselves seeking to promote a particular agenda or preference (Belk et al., 2025).

Basic Science refers to the foundational study of the natural world that focuses on understanding the principles, concepts, and processes that govern life and physical phenomena. It emphasizes the acquisition of knowledge about the physical, chemical, and biological environment without immediate concern for practical application. In the context of education, Basic Science is designed to provide learners with a broad-based understanding of scientific principles and to develop their scientific literacy, problem-solving skills, and curiosity about the natural world (Arop, 2015). At the secondary school level, particularly in Nigeria, Basic Science is introduced as an integrated subject that merges aspects of physics, chemistry, biology, and earth science into a single curriculum. The aim is to enable students to perceive science holistically, foster positive attitudes toward inquiry, and equip them with competencies for future study in specialized science disciplines (NERDC, 2007; Ogunlaye, 2020). Furthermore, Basic Science serves as a bridge between everyday experiences and advanced scientific concepts, preparing learners not only for academic pursuits but also for technological and societal problem-solving. It is therefore considered a vital foundation for scientific literacy and national development (Kassa, 2024).

The use of multimedia in teaching Basic Science is increasingly recognized as a transformative approach in Nigerian secondary education. Multimedia, which integrates text, audio, video, animation, and interactive graphics, enhances the teaching learning process by making abstract scientific concepts more concrete and engaging (Mayer, 2021). Use of multimedia improves students understanding of abstract concepts. Basic science topics such as photosynthesis, human anatomy, or states of matter often involve abstract processes that are difficult for learners to visualize. Multimedia applications provide simulations and visual representations that simplify such concepts, leading to better comprehension and retention (Ogunlaye, 2020). According to Bas andBeyhan (2019), use of multimedia enhances motivation and engagement. Students in Nigerian classrooms often perceive science as difficult and disconnected from daily life. The use of multimedia videos, animations, and interactive demonstrations—makes learning more interactive and enjoyable, which in turn stimulates students' interest and motivation.

Also, the fact that, many Nigerian schools lack well-equipped laboratories, It bridges resource gaps in schools. Multimedia resources can serve as virtual laboratories, giving students access to experiments and demonstrations that would otherwise be impossible due to infrastructural or financial constraints (Arop, 2015). Multimedia supports differentiated learning as it caters to different learning styles (visual, auditory, kinesthetic), which is crucial in diverse Nigerian classrooms. By accommodating learners' differences, it promotes inclusive education and reduces the achievement gap (Mayer, 2021; Kassa, 2024). According to Wang et al. (2024) it

prepares students for the digital age. In line with global educational reforms, integrating multimedia in Basic Science fosters 21st-century skills such as digital literacy, problem-solving, and critical thinking. This positions Nigerian students to compete favorably in science and technology-driven economies.

Theoretical Framework

This study is guided by the Multimedia Learning Theory (MMLT) proposed by Mayer (1997) and the Cognitive Learning Theory (CLT) proposed by Jean Piaget (1962) in Shukri and Toran, (2025). The Mayer's Multimedia Learning Theory falls under the grand theory of Cognitivism. According to Mayer (1997), multimedia learning theory consists of three aspects that help students learn more effectively. The first one is that there are two channels, namely audio and visual, for information processing; this is also known as the multimedia principle. This principle states that, students may learn better from images and words than just from words. The second aspect is that, each channel has a limited capacity to process information. In other words, human beings can only process information in limited amounts, and they try to understand the information by creating mental representations from the information sources. The last aspect is that learning is an active process of filtering, selecting, organizing, and integrating information based on existing knowledge. This theory directly relates with the multimedia teaching strategy in the sense that, a combination of multiple types of media where employed in the form of audio, video, image and texts for motivating students to learn effectively and they can be creating mental representations from the information source.

Literature Review

In a research carried out by Ezeudu and Ezinwanne (2019), a quasi-experimental study showed that students taught Basic Science using multimedia resources outperformed those taught through traditional lecture methods. Retention scores were also higher in the experimental group. Another experimental study by Ogunleye and Abdullahi (2020) revealed that, multimedia instruction in Basic Science and Technology significantly enhanced both immediate achievement and delayed retention compared to conventional methods. Male and female students benefited equally, suggesting gender neutrality of multimedia effects. Akinbadewa (2020) reported that, computer-based multimedia packages improved Biology achievement in Oyo State. Students exposed to animation and interactive media demonstrated greater conceptual understanding than those using textbooks alone. Gambari, Shittu and Ogunlade (2020) found that computer-assisted instruction boosted achievement and motivation in science among Nigerian secondary school students. Importantly, their findings indicated that teacher training in multimedia delivery was a key determinant of success.

Bello, Musa and Musa (2023) conducted their study in Kano State using multimedia. The outcome of the study showed that, multimedia teaching methods enhanced Physics performance and motivation, though effects were moderated by infrastructure availability (e.g., electricity, functioning projectors) and teachers' ICT competence. For regional comparison, studies in Ghana and Sierra Leone (Adarkwa, 2021; Kamara, 2022) corroborated Nigerian findings, showing that integrating multimedia into science lessons improved problem-solving skills, critical thinking, and learner engagement across West Africa. In this respect and on the basis of synthesis, across Nigeria and neighboring countries, evidence consistently demonstrates that

multimedia interventions outperform conventional lecture methods. However, contextual factors like teacher competence, infrastructural support, and fidelity of implementation strongly influence outcomes.

Statement of the Problem

In Wudil Education Zone, anecdotal and examination evidence suggest suboptimal Basic Science outcomes, reflected in below-average pass rates in Basic Science at junior secondary school level. Teachers predominantly rely on chalk-and-talk methods with limited integration of ICT, animations, or digital media (Bello et al., 2023). Infrastructural challenges such as irregular electricity supply, inadequate computer labs, and lack of multimedia projectors further limit exposure to technology-enhanced instruction (Kassa, 2024). Despite positive findings of multimedia interventions in other Nigerian states, little is known about their effectiveness in Wudil Education Zone where contextual factors such as socio-economic background, teacher preparedness, and resource allocation may alter outcomes. This knowledge gap underscores the need for localized empirical research to provide evidence for curriculum planners, teachers, and policymakers in Kano State.

Research Objectives

The objectives of the study were to:

1. To determine if there is any significant difference in the mean academic performance of basic science students taught using multimedia and those taught using the conventional method.
2. To determine if there is any significant difference in the mean academic performance of male basic science students taught using multimedia and those taught using the conventional method.
3. To determine if there is any significant difference in the mean academic performance of female basic science students taught using multimedia and those taught using conventional method.

Research questions

In line with the specific objectives of the study, the following research questions were formulated

1. Is there any significant difference in the mean academic performance of basic science students taught using multimedia and those taught using the conventional method?
2. Is there any significant difference in the mean academic performance of male basic science students taught using multimedia and those taught using the conventional method?
3. Is there any significant difference in the mean academic performance of female basic science students taught using multimedia and those taught using the conventional method?

Research Hypotheses

In line with the research questions, the following null hypotheses were tested at a 0.05 confidence level

H₀₁: There is no significant difference in the mean academic performance of basic science students taught using multimedia and those taught using the conventional method.

H₀₂: There is no significant difference in the mean academic performance of male basic science students taught using multimedia and those taught using the conventional method.

H₀₃: There is no significant difference in the mean academic performance of female basic science students taught using multimedia and those taught using the conventional method.

Significance of the Study

i. Educational Impact (Students)

It will whether multimedia teaching actually improves students' understanding, retention, and examination performance in Basic Science providing direct evidence for classroom practice in the local context.

ii. Pedagogical Implications (Teachers)

It will provide teachers with locally relevant evidence on instructional methods, helping them to choose, adapt, or justify multimedia approaches (e.g., animations, simulations, and videos) over or alongside traditional methods.

iii. Curriculum and Instructional Design

It will inform curriculum planners and textbook authors about which multimedia elements support learning objectives in Basic Science, thereby aiding integration into syllabi, lesson plans, and teacher guides.

iv. Policy and Administration

It will offer evidence for school administrators and education policymakers in Kano State (and similar contexts) to invest in ICT, teacher training, and infrastructure if multimedia use is shown to enhance student achievement.

v. Professional Development and Teacher Training

It will identify specific teacher competencies and training needs (such as lesson design and classroom management using technology), which are useful for planning in-service and pre-service teacher education programs.

iv. Resource Allocation and Cost-Effectiveness

It will help to determine whether investments in multimedia facilities—such as hardware, software, and teacher training produce measurable learning gains that justify the associated costs, especially in resource-limited contexts.

vi. Theoretical Contribution

It will test and refine learning theories (such as multimedia learning, cognitive load, and constructivism) within a Nigerian secondary-school context, thereby contributing to contextually grounded educational theory.

vii. Basis for Further Research

It will identify gaps, limitations, and new research questions—such as long-term retention or subject transferability that can inform future studies in science education and educational technology.

Research Methodology

Research Design: The study adopted a quasi-experimental design, specifically the non-equivalent control group design. This design was chosen because it allows for comparison between groups that were not randomly assigned but are naturally existing classes. It involves a

pre-test and post-test administered to both experimental and control groups. The experimental groups were taught Basic Science using multimedia instructional strategies, while the control groups were taught using the conventional lecture method. This design was considered appropriate for school settings where randomization of students into groups is often impractical (Creswell & Creswell, 2023).

Population of the Study: The population of the study comprised 4,796 Junior Secondary School (JSS II) students from the 26 public junior secondary schools within the Wudil Education Zone of Kano State. The focus on JSS II students was due to their exposure to fundamental Basic Science concepts, which are essential for measuring cognitive achievement in science-related subjects.

Sample and Sampling Technique

A total of 161 students were selected from four junior secondary schools using a purposive sampling technique. Two boys' schools and two girls' schools were selected to ensure gender representation. One boys' and one girls' school were assigned to the experimental groups, while the remaining two served as control groups. The purposive selection was based on factors such as the schools' accessibility, availability of multimedia facilities, and willingness of teachers to participate in the study.

Research Instruments

The principal instrument used for data collection was the Wudil Basic Science Achievement Test (WBSAT). The instrument was designed by the researcher to measure students' academic achievement in selected Basic Science topics taught during the study. The WBSAT consisted of 40 multiple-choice and short structured items, drawn from the JSS II Basic Science curriculum, covering topics suitable for multimedia presentation such as The Solar System, Energy Transformation, and States of Matter. The test was used for both pretest and posttest administration to assess students' achievement before and after exposure to the instructional methods.

Validity of the Instrument

To ensure content and face validity, the WBSAT was reviewed by three experts: two from the Department of Science Education and one from the Department of Educational Measurement and Evaluation at Bayero University, Kano. The experts examined the test items for clarity, relevance, difficulty level, and alignment with the curriculum objectives. Their suggestions were incorporated before the final version of the instrument was produced.

Reliability of the Instrument

The reliability of the WBSAT was established through a pilot study conducted on 30 JSS II students outside the sample schools but within the same education zone. The reliability coefficient was computed using the Kuder-Richardson Formula 20 (KR-20), which yielded a coefficient of 0.82, indicating that the instrument was sufficiently reliable for the study (Fraenkel & Wallen, 2020).

Experimental Procedure

The study lasted for six weeks, comprising both pretesting and posttesting sessions. For the Pretest, both the experimental and control groups were administered the WBSAT before the commencement of treatment to establish baseline equivalence in academic achievement. The experimental groups were taught selected Basic Science topics using multimedia instructional materials, which included animations, PowerPoint slides, videos, and interactive simulations. The control groups were taught the same topics using the conventional lecture method, which involved verbal explanation, chalkboard illustrations, and note-taking. All groups received instruction for the same duration, and lessons were taught by trained Basic Science teachers under the supervision of the researcher. For the posttest, after the treatment, both groups were re-administered the same WBSAT to measure academic achievement gains attributable to the teaching methods.

Method of Data Collection

Data were collected through the administration of pretest and posttest scores using the WBSAT. The researcher personally coordinated the process, assisted by the participating teachers. Each test session lasted for 40 minutes, and all test papers were collected immediately after completion to ensure data integrity.

Method of Data Analysis

The data obtained were analyzed using both descriptive and inferential statistical methods. Descriptive statistics such as mean and standard deviation were used to summarize students' achievement scores. Inferential statistics, specifically the t-test, was employed to test the hypotheses at a 0.05 level of significance, in order to determine whether significant differences existed between the mean scores of students taught with multimedia and those taught using the conventional method.

Data Presentation, Analysis and Discussion

The data were analyzed in accordance with the three research questions and corresponding hypotheses formulated in Chapter One. The analysis compared the mean academic achievement scores of students taught using multimedia (experimental groups) and those taught using the conventional method (control groups). The hypotheses were tested at a 0.05 level of significance using independent samples t-test.

Research Question 1: Is there any significant difference in the mean academic performance of basic science students taught using multimedia and those taught using the conventional method?

Table 1.1: Mean and Standard Deviation of Experimental and Control Groups

Group	N	Mean	Std. Deviation	Mean Difference
Experimental	89	68.74	7.82	8.79
Control	72	59.95	8.10	

Table 1.1 shows that students in the experimental group taught using multimedia recorded a higher mean achievement score ($M = 68.74$, $SD = 7.82$) than their counterparts taught using the conventional method ($M = 59.95$, $SD = 8.10$). This suggests that multimedia instruction enhanced students' understanding and performance in Basic Science. To test for significance of

the mean difference, null hypothesis one was tested. To test for significance of the mean difference, null hypothesis one was tested.

H₀₁:There is no significant difference in the mean academic performance of basic science students taught using multimedia and those taught using the conventional method.

Table 1.2: Independent Samples t-test on Academic Achievement of Experimental and Control Groups

Groups	N	Mean	SD	df	t-cal	t-crit	P-value	R
Experimental	89	68.74	7.82	159	6.23	1.96	0.001	Sig
Control	72	59.95	8.10					

Significant at $P \leq 0.05$ level

Since the calculated t-value ($t = 6.23$, $p < 0.05$) is greater than the critical value (1.96), the null hypothesis (H_{01}) is rejected. This implies that there is a significant difference in the mean academic performance between students taught using multimedia and those taught using the conventional method, in favour of the multimedia group.

Research question 2: Is there any significant difference in the mean academic performance of male basic science students taught using multimedia and those taught using the conventional method?

Table 2.1: Mean and Standard Deviation of Male Experimental and Control Groups

Group	N	Mean	Std. Deviation	Mean Difference
Male Experimental	45	69.22	7.51	8.92
Male Control	35	60.30	8.43	

The results presented in Table 2.1 show that the male students in the experimental group (taught using multimedia) obtained a higher mean achievement score ($M = 69.22$, $SD = 7.51$) than their counterparts in the control group who were taught using the conventional method ($M = 60.30$, $SD = 8.43$). The mean difference of 8.92 points suggests that multimedia instruction had a positive effect on the academic achievement of male students in Basic Science. To test for significance of the mean difference, null hypothesis two was tested as follows.

H₀₂:There is no significant difference in the mean academic performance of male basic science students taught using multimedia and those taught using the conventional method.

Table 2.2: t-test Analysis for Male Students' Achievement Scores

Groups	N	Mean	SD	df	t-cal	t-crit	P-value	R
Experimental (Male)	45	69.22	7.51	78	4.88	1.99	0.001	Sig
Control (Male)	35	60.32	8.43					

Significant at $P \leq 0.05$ level

The t-test result ($t = 4.88$, $p < 0.05$) indicates a statistically significant difference in favour of male students exposed to multimedia instruction. This suggests that multimedia enhanced male students' engagement and comprehension in Basic Science lessons.

Research question 3: Is there any significant difference in the mean academic performance of female basic science students taught using multimedia and those taught using the conventional method?

Table 3.1: Mean and Standard Deviation of Female Experimental and Control Groups

Group	N	Mean	Std. Deviation	Mean Difference
Female Experimental	44	68.20	7.90	8.63
Female Control	37	59.57	8.25	

The results displayed in Table 3.1 indicate that female students in the experimental group (those taught using multimedia) achieved a higher mean score ($M = 68.20$, $SD = 7.90$) than their counterparts in the control group who were taught using the conventional lecture method ($M = 59.57$, $SD = 8.25$). The mean difference of 8.63 points reveals a substantial improvement in the academic performance of female students exposed to multimedia instruction. To test for significance of the mean difference, null hypothesis three was tested as follows.

HO₃: There is no significant difference in the mean academic performance of female basic science students taught using multimedia and those taught using the conventional method.

Table 3.2: t-test Analysis for Female Students' Achievement Scores

Groups	N	Mean	SD	df	t-cal	t-crit	P-value	R
Experimental (Female)	44	68.20	7.90	79	4.52	1.99	0.001	Sig
Control (Female)	37	59.57	8.25					

Significant at $P \leq 0.05$ level

The calculated t-value (4.52) exceeds the critical value (1.99) at $p < 0.05$. Therefore, HO₃ is rejected. This shows that the use of multimedia significantly improved the academic performance of female students in Basic Science compared to those taught with the conventional method.

Summary of Findings

1. There was a significant difference in the mean academic achievement of students taught using multimedia and those taught using the conventional method, in favour of the multimedia group.
2. Male students taught with multimedia performed significantly better than their counterparts taught with the conventional method.
3. Female students taught using multimedia equally performed significantly better than those taught using the conventional method.

Discussion of Findings

The results of this study indicate that multimedia instruction significantly enhances students' academic achievement in Basic Science. The findings corroborate the assertions of Kassa (2024) and Arop (2015) who observed that multimedia resources make learning more interactive, engaging, and effective in science education. Similarly, Ogunlaye (2020) reported that multimedia promotes students' retention and conceptual understanding by integrating audio-visual and interactive content. Furthermore, the findings align with Cognitive Theory of Multimedia Learning (Mayer, 2021), which posits that learners understand and retain

information better when it is presented through both verbal and visual channels. The improved performance among both male and female students indicates that multimedia serves as an equitable instructional tool that benefits all learners irrespective of gender.

Conclusion

Based on the findings, the study concludes that the use of multimedia instructional strategies substantially improves students' academic achievement in Basic Science. Multimedia creates an interactive, engaging, and visually stimulating learning environment that enhances conceptual understanding, retention, and interest among learners. The study further concludes that both male and female students benefit equally from multimedia instruction, implying that multimedia serves as a gender-friendly pedagogical tool. The results confirm the Cognitive Theory of Multimedia Learning (Mayer, 2021), which emphasizes that people learn more deeply from words and pictures than from words alone. Hence, adopting multimedia technologies in the teaching of Basic Science can effectively bridge learning gaps associated with traditional teaching methods, foster scientific thinking, and improve performance outcomes.

Recommendations

In line with the findings and conclusions of this study, the following recommendations are made:

1. **Integration of Multimedia into Science Instruction:**
The Federal and State Ministries of Education should encourage the use of multimedia instructional tools in Basic Science classes to improve achievement levels.
2. **Teacher Training:**
Teacher education institutions and professional bodies should include practical courses on multimedia development and application in science education curricula.
3. **Provision of ICT Infrastructure:**
Government and school authorities should equip laboratories and classrooms with projectors, computers, internet access, and other multimedia resources to support effective instruction.
4. **Curriculum Review:**
The Nigerian Educational Research and Development Council (NERDC) should revise the Basic Science curriculum to embed multimedia-based pedagogical strategies.
5. **Motivation of Teachers:**
Teachers who creatively use multimedia should be recognized and rewarded to motivate others to adopt technology-enhanced teaching practices.

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