

EFFECT OF MULTIMEDIA INSTRUCTIONAL STRATEGY ON SENIOR SECONDARY SCHOOL STUDENTS' ACADEMIC PERFORMANCE IN MATHEMATICS IN KOGI STATE.

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Abstract

The study investigated Effects of multimedia instructional strategy on senior secondary school students' academic performance in mathematics, Kogi State. To achieve this, two research questions and two hypotheses were formulated to guide the study. Quasi-experimental design, specifically the pre-test, post-test, non-equivalent and non-randomized control group was adopted for the study. The population of this study consisted of 12703 (6,680 male and 6,023 female) Senior Secondary (SS II) students in 236 public senior secondary schools in Kogi State. The sample consisted 239 (male 132 female 107) Senior Secondary school students (SSII) who are offering Mathematics in four intact classes located in four public secondary schools in Kogi State obtained using multi-stage sampling. The instrument used for data collection was algebra performance Test (APT). Mean and standard deviation were used to answer the research questions, while analysis of covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance. The finding showed that, there was

a statistically significant difference between the academic performance means scores of students in Algebra when exposed to multimedia instructional strategy and conventional lecture strategy in favour of the multimedia instructional strategy with high mean. The finding also indicated that, there was no statistically significant difference between the academic performance means scores of male and female students taught algebra using multimedia instructional strategy. It was recommended that to increase students' academic performance in algebra, mathematics teachers should employ multimedia instructional strategies when teaching algebra. Government through the federal and state ministries of education should provide the required instructional materials necessary for the use of multimedia instructional strategies to improve male and female students' understanding of the various terminologies in Mathematics, also mathematics teachers should be sponsor constantly on in-service training on the use of multimedia instructional strategy

Keywords: multimedia instructional strategy, academic performance, mathematics.

Introduction

Mathematics is a discipline, a method, and a language, relevant not only in other disciplines but also to mathematics itself. It is a mode of organizing, validating, and communicating knowledge, which uses the principles of logic and in which the truths of propositions are universally valid. It investigates concepts of nature and its degree of generality is self-referential and self-applicable, as is in fact human reason (Barboianu, 2022). Mathematics may also be described as the study of patterns and relationships between numbers, quantities, shapes, and structures. It involves logical reasoning and precise language to formulate, analyze, and solve problems. This may be through the conducting operations with numbers, quantities, shapes, patterns, and the relationships between them. Nations that are seemed to be developed and largely considered as civilized have achieved this status through effective mathematics education for the citizens (Achimugu, & Igbogwu, 2021).

According to Stewart (2017), Mathematic involves the study of structure, order, and relation that has evolved from elemental practices of counting, measuring, and describing the shapes of objects. Hence, we cannot ignore the importance of Mathematics (Boaler, 2016). Mathematical application is a very important, one need good knowledge of mathematics in having a good degree in the following areas; Chemistry, Physics, Engineering, Biology, Pharmacy (Achimugu, & Igbogwu, 2021). Nigeria as a country realized the usefulness of Mathematics to national socio-economic development thus has made efforts to impart knowledge and skills of Mathematics in all her citizens at all levels of education. Mathematic as stated in the National Policy on Education by the Federal Republic of Nigeria (FRN, 2020) is a core subject for students at the basic and

senior secondary school levels of education. To emphasize the importance of Mathematics, Nwoke and Ajuzie (2021) affirm that the teaching and learning of mathematics in secondary schools is geared towards developing the nation in terms of scientist, technologists, doctors, engineers and other professions. Also, a credit pass in Mathematics is one of the prerequisites to secure admission into tertiary institutions in Nigeria to study most courses (Kurumeh & Onah, 2013). Mathematics is globally acknowledge as the bedrock of scientific and technological development. Mathematics is relevant to everyday life and can be seen as the pivot on which all other subjects revolve. Nations that are seemed to be developed and largely considered as civilized have achieved this status through effective mathematics education for the citizens (Achimugu *et al.*, 2024). Despite the indispensability of Mathematics in the development of humanity particularly Nigerian citizens, it has witnessed persistent failure by students in both internal and public examinations. In Nigeria, students' abysmal academic performance in Mathematics has been reported by researchers

Multimedia instructional strategy involve the integration of various forms of media, such as text, audio, video, graphics, and interactive content and animations. Igbibo and Otuturu (2019) multi-media deals with the incorporation and integration of media into a structured, systematic presentation. Nwoke et al. (2016) describe multimedia as the combination of various digital media types, such as text, images, sound and video, into an integrated multisensory interactive application or presentation to convey a message or information to an audience. Multimedia is multi-sensory technology that stimulates multiple senses of the audience at a time. Its interactive nature enables teachers to control the content and flow of information (Shah & Khan, 2015; Silva & Almeida, 2023; Ode 2023). Multimedia applications, internet search engines and creation of models for simulation in lessons should be encouraged. It could also appeal to multiple senses, which can make the learning experience more engaging and enjoyable. Hence, help students understand and remember complex Mathematical concepts better. This hands-on approach can deepen understanding and enhance critical thinking skills. Tools like collaborative documents, discussion forums, and multimedia presentations foster collaboration and creative thinking among students (Gopalan & Klann, 2023; Idoko, & Amaha (2023). Thus, could stimulating and foster interest and academic performance in Mathematics. It can bring real-world scenarios into the classroom through the use of photo-math, documentaries, interviews, and virtual tours, making learning more relevant and relatable.

Academic performance is a measurable construct, and the conventional way of measuring it is through testing. Several variables contribute to student's poor academic performance but one of the most commonly stated issues is the employment of ineffective teaching methods (Achimugu, 2018). Achor (2017) notes that academic performance is measured by the final grade earned in the

subject. Academic performance may also be a measure of output and the main changes in knowledge, skills and attitude of individuals as a result of experiences acquired. Mekonnen (2014); Idoko et al (2021) describes academic performance as the scholastic standing of a student at an academic task. As low academic performance in Mathematics continues, the economic growth of the nation is in jeopardy. The use of conventional lecture strategy and other similar teacher-centered strategy by Mathematics teachers at the secondary school level leads to memorization of facts and concepts. This may be the reason for the academic performance of students offering Mathematics. As such, there is a need to investigate and use strategies that can improve students' interest and academic performance in algebra. Hence, the researcher seeks to find out if the use of multimedia instructional strategy could enhance senior secondary school students' academic performance in algebra in Kogi State.

Gender is an attribute that has to do with social, psychological, and cultural attributes of male and females. According to (Nnamani & Oyibe 2016; Idoko & Nnamani 2019). gender is a social connotation that has sound psychological background, and is used to refer to specific cultural patterns of behaviour that are attributed to male or female students. Okwara et al. (2017) revealed that gender influences students' performance of science and mathematics subjects in favour of male. Also, Akinoso (2018) found that there was a significant effect existed on treatment and gender, but, male have high performance mean score than female counterparts. Oribhabor (2020) found that there is a significant difference in the Mathematics achievement of the male and female students in favour of the males. Thus, the researcher is inspired to conduct this study to investigate effect of multimedia instructional strategy on senior secondary school male and female students' academic performance in Mathematics, in Kogi State.

Research Questions

The following research questions guided the study

1. What is the difference between the performance mean scores of students taught algebra using multimedia instructional strategy and those taught with conventional lecture strategy?
2. What is the difference between the mean academic performance scores of male and female students taught algebra using multimedia instructional strategy?

Hypotheses

The following null hypotheses were formulated and tested at an alpha level of 0.05 of significance.

Ho1: There is no statistical significant difference between the performance mean scores of students taught algebra using multimedia instructional strategy and those taught with conventional lecture strategy.

Ho2: There is no statistical significant difference between the mean academic performance scores of male and female students taught algebra using multimedia instructional strategy.

Methodology

The target population for the study consisted of 12703 (6,680 male and 6,023 female) Senior Secondary (SS II) students in 236 public senior secondary schools in Kogi State. The sample consisted 239 (male 132 female 107) Senior Secondary II students who are offering Mathematics in four intact classes located in four public secondary schools in Kogi State obtained using multi-stage sampling. At the first stage simple random sampling technique will use to select four Educational zones which are Ankpa, Dekina okene and Kabba. Secondly, purposive sampling was used to select four senior secondary schools, one in each selected educational zone. This is to ensure uniformity of standard and to ensure that the schools are equidistant from one another. Thirdly random sampling will be utilized to obtain the arm to be used for this study where there are more than one arm, Furthermore, two secondary schools were randomly assigned to experimental group and two to control group using hat and draw method without replacement. This was done to ensure that equal chance were given to each school to be selected as the experimental group. The researcher wrote the first letter of names of the four sampled schools on a piece of paper, folded and dropped them in a hat. The first two schools drawn was registered as experimental group and was not replaced. Then remaining two was registered as the control group. This sample of 239 students consists of 120 students in the experimental class and 119 students in the conventional class. Two intact classes were assigned to each of the strategies (experimental groups and a control group). The instrument used for this study was the Algebra academic performance test (APT) it was developed by the researcher and consisted of twenty five (25) questions. Each question was scored four marks, making a total of 100% marks. The instrument was validated by the by experts in mathematics and in science Education.



Results

Research Question One:

What is the difference between the mean performance scores of students taught algebra using multimedia instructional strategy and those taught with conventional teaching strategy?

Table 1: Showing Pre-test/Post-test Academic Performance Mean Scores of Students in Experimental and Control Groups

	Pretest	Posttest
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Strategy	N		SD		SD	Mean gain
Multimedia Inst. Strategy	120	35.40	7.94	65.66	9.30	30.26
lecture strategy	119	34.76	9.95	42.87	8.32	8.17

Result in Table 1. Showed the pre-test and post-test mean performance scores of Students taught algebra using multimedia instructional strategy and those taught using lecture strategy. Based on the result showed in the table above multimedia instructional strategy improved students' academic performance in Algebra more than conventional lecture strategy with multimedia instructional strategy proving more efficacious.

Research Question Two:

What is the difference between the mean academic performance scores of male and female students taught algebra using multimedia instructional strategy?

Table 2: Showing Pre-test/Post-test of the Academic Performance Mean Scores of Male and Female Students in Experimental Group

Gender	N	Pretest	SD	Posttest	SD	Mean Gain	Mean Difference
							
Male	64	42.88	6.21	61.50	5.51	18.62	0.3
Female	56	42.10	8.42	60.44	6.53	18.34	

Result in Table 2 showed the influence of gender on the mean academic performance of students' taught algebra using multimedia instructional strategy. Result showed that male students had pre-test mean academic performance score of (=42.88, SD = 6.21) and a post-test mean academic performance score of (= 61.50, SD = 5.51), while the female students had a pre-test mean academic performance score of (=42.10, SD = 8.42) and a post-test mean academic performance score (= 60.44, SD = 6.53). Result showed that the male students performed slightly higher than their female counterparts with mean gain of 18.62 while the female students had mean gain of 18.34 resulting to a mean difference of 0.3 in favour of the male counterpart.

Testing of Hypotheses

HO₁: There is no difference between the mean performance scores of students taught algebra using multimedia instructional strategy and those taught with conventional teaching strategy.

Table 3: Showing Analysis of Covariance (ANCOVA) of Difference in the Academic Performance Mean Scores of Students in the Experimental Group.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared	Dec.
Corrected Model	1841.297 ^a	13	141.638	16.685	0.00	0.24	
Intercept	50.641	1	50.265	5.921	0.16	0.78	
Pretest	298.828	1	298.641	35.180	0.00	0.00	
Strategy	55.034	1	54.049	6.483	0.01	0.15	S
Gender	164.133	3	54.711	59.640	0.00	0.08	
Strategy * Gender	1.000	2	.000	.010	0.45	0.00	
Error	984.711	214	19.681				
Total	496735.000	237					
Corrected Total	2826.008	239					

Note: S = Significant, NS = Not Significant and η^2_p = partial eta squared

The result in Table 3 showed the ANCOVA of the difference in the academic performance mean scores of students in Algebra when exposed to multimedia instructional strategy and conventional lecture strategy. The result was statistically significant at (F) =6.483, p = 0.01, η^2_p = 0.15). Since the associated probability value of 0.01 is less than 0.05 set as level of significance, the null hypothesis was rejected. Thus, inference drawn is that there was a statistically significant difference in the academic performance means scores of students in Algebra when exposed to multimedia instructional strategy and conventional lecture strategy in favour of the treatment group with high mean.

H₀₂: There is no significant difference between the mean academic performance scores of male and female students taught algebra using multimedia instructional strategy in Kogi State

Table 4: Showing Analysis of Covariance (ANCOVA) of the Difference in the Academic Performance Mean Score of Male and Female Students in the Experimental Group

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Dec.
Corrected Model	1806.728 ^a	10	180.673	17.940	0.00	0.75	
Intercept	0.004	1	.004	.000	0.98	0.00	
Pretest	416.941	1	416.941	41.401	0.00	0.42	
Strategy	90.066	2	45.033	4.472	0.16	0.17	
Gender	120.578	1	60.289	6.232	0.23	0.18	NS
Strategy *Gender	0.000	2	0.00	.060	0.10	0.08	
Error	523.684	235	10.071				
Total	235535.000	238					
Corrected Total	2330.413	239					

Note: S = Significant, NS = Not Significant and η^2_p = partial eta squared

The result on Table 4. Shows the ANCOVA of the difference in the academic performance mean score of male and female students taught algebra using multimedia instructional strategy in Kogi State. Based on the table above the null hypothesis was accepted. Thus, inference drawn is that there was no statistically significant difference in the academic performance mean score of male and female students taught algebra using multimedia instructional strategy in Kogi State secondary schools.

Discussion of Findings

The result showed that multimedia instructional strategy had effect on the academic performance mean scores of students in Algebra. This means that, multimedia instructional strategy had a significant effect on students' academic performance in algebra than the conventional lecture strategy. The finding also shows that there was a significant difference in the academic performance mean scores of students in Algebra when exposed to multimedia instructional strategy and conventional lecture strategy in favour of the multimedia instructional strategy with high mean. The finding further showed the effect size ($\eta^2_p = 0.15$), which indicates that fifteen percent (15%) variance in the academic performance mean scores of students in Algebra when exposed to multimedia instructional strategy can be explained by conventional lecture strategy. Academic Performance is a measurable construct, and the conventional way of measuring it is through testing. Several variables contribute to students' poor academic performance but one of the most commonly stated issues is the employment of ineffective teaching strategy (Achimugu, 2018). This means that academic performance deals with the measure of how much new knowledge, skills interest and attitudes students have obtained as a result of their exposure to strategy of teaching. Conventional teaching strategy provide a structured approach to learning, which can be helpful for students who thrive on routine. The use of multimedia in Mathematics classroom increases students' motivation and makes them active learners. With multimedia teachers can motivate students to learn by using their different senses and through audio-visual presentation of information, the students obtained clearer and more complete knowledge of the outside world and themselves. Multimedia resources, such as videos, animations, and simulations, help students visualize complex concepts, making them easier to understand and retain. Interactive multimedia elements, like quizzes, games, and discussions, encourage active learning, which enhances retention and recall of information. Instructional strategies can be tailored to individual students' needs, learning styles, and pace, promoting personalized learning experiences. Multimedia resources can provide students with access to current, relevant, and accurate information, which may not be available through traditional textbooks. The study also agrees Enikanolaye (2021) who studied the effects of multimedia instructional strategy on senior school students' performance and retention in Mathematics and found that there was a significant difference

between the experimental groups taught mathematics using multimedia and the control group taught mathematics using conventional strategy. Instructional strategies incorporate visual, auditory, and interactive elements that capture students' attention, promoting engagement and motivation. The finding agrees with Umar et al. (2020) who investigated on the impact of multimedia instructional strategies on students' achievement and retention in basic science and technology in Minna, Niger State and found that students who were taught basic science and technology using multimedia instructional strategies achieved and retained higher than those taught without instructional strategies. Result showed that male students slightly outperformed higher than their female counterparts when taught with multimedia instructional strategy. The study further tested using hypothesis and the finding showed that there was no significant difference in the academic performance mean score of male and female students taught algebra using multimedia instructional strategy in Kogi State secondary schools. The study found that male students slightly outperformed their female counterparts when taught using multimedia instructional strategies. However, further analysis using hypothesis testing revealed that there was no significant difference in the academic performance mean scores of male and female students.

The finding that there significant difference in the academic performance mean scores of male and female students suggests that multimedia instructional strategies can help narrow the gender gap in mathematics education are The study's outcome implies that multimedia instructional strategies can provide equitable learning opportunities for both male and female students, which can help promote gender equality in education. The finding that male and female students performed similarly when taught using multimedia instructional strategies suggests that this approach can help reduce stereotype threat, which can hinder female students' performance in mathematics. The study's outcome can inform instructional design, highlighting the importance of incorporating multimedia elements to promote equitable learning outcomes for both male and female students. The study is consistent with the finding of Oribhabor, (2020) who examined the influence of gender on academic achievement in Mathematics among senior secondary school students in Bayelsa State and found that there is a significant difference in the Mathematics achievement of the male and female students in favour of the males. The finding of the study agrees with Akinoso (2018) who carried out a research on the effects of multimedia on students' performance in secondary school mathematics and found no significant difference existed between the performance of male and female students in both experimental and control group. The finding agrees with Umar et al. (2020) who investigated on the impact of multimedia instructional strategies on students' achievement and retention in basic science and technology in Minna, Niger State and found no significant difference existed

between the performance of male and female students in both experimental and control group.

Conclusion

The findings showed that there was a significant difference in the academic performance means scores of students in Algebra when exposed to multimedia instructional strategy and conventional lecture strategy in favour of multimedia instructional strategy with high mean. The finding indicated that, there was no statistically significant difference in the academic performance means score of male and female students taught algebra using multimedia instructional strategy.

Recommendations

The following recommendations were made based on the findings of the study.

1. To increase students' academic performance in algebra, mathematics teachers should employ the use of multimedia instructional strategies when teaching algebra.
2. Government through the federal and state ministries of education should provide the required instructional materials necessary for the use of multimedia instructional strategies to improve male and female students' understanding of the various terminologies in Mathematics.
3. Government through the federal and state ministries of education should sponsor Mathematics teachers constantly on in-service training on the use of multimedia instructional strategy.

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