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EFFECT OF AUDIO-VISUAL MATERIALS ON SENIOR SECONDARY SCHOOL STUDENTS' ACADEMIC ACHIEVEMENT IN MATHEMATICS IN YOLA EDUCATION ZONE, ADAMAWA STATE, NIGERIA

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ABSTRACT

This study examined the effect of audio-visual materials on senior secondary school students' academic achievement in Yola Education Zone, Adamawa State. The study centred on three research questions and three hypotheses that were tested at a significance level of 0.05. Quasi-experimental research process was adopted and by which 130 students were sampled to form an Experimental Group (X_1) and a Control Group (X_2). Four senior secondary schools from different Local Government in the Zone made up the Experimental and Control Groups that were given instructional treatment where Mathematics was taught with the use of audio-visual materials. A pilot test was conducted in schools outside Yola Education Zone and data analysed from it produced result that gave a reliability index of 0.80 that was considered appropriate for the study. A Mathematics Achievement Test (MAT) was designed by the researchers and validated, then used for both pre-test and post-test. The findings showed that the use of audio-visual materials significantly supports the academic performance of the senior secondary school students. The results also showed that no significant difference in academic achievement occurs between boys and girls when the audio-visual materials were used unlike when teachers do not use audio-visual materials to teach Mathematics. It was therefore concluded that the use of audio-visual materials is a dependable way to improve and maintain a strong achievement of students in their study of Mathematics in senior secondary school classes. Thus, it was recommended among others that schools should try to have relevant audio-visual materials in the school and the mathematics teachers should always try to use such materials in teaching Mathematics.

Keywords: Audio-Visual Materials, Mathematics, Instructional Materials, Students' Academic Achievement, Yola Education Zone

INTRODUCTION

Instructional materials play a vital role in enhancing the teaching and learning process. They provide concrete experiences that help students understand abstract concepts, making learning more engaging and effective. The use of instructional materials in the teaching and learning of Mathematics in secondary schools is always a necessity. This is more so when one considers that Mathematics is an area of abstract learning for which mastery requires an inner thinking of the learner (Kajuru & Kauru, 2017). Moreover, Mathematics has relevance to all individuals especially when one's effective functioning in the modern society is taken into account (Chianson, Kurumeh & Obida, 2019). The study of Mathematics in senior secondary schools is crucial for students' academic achievement and future career prospects. However, many students face significant challenges in mastering mathematical concepts, which impacts their overall academic performance and future opportunities.

Academic achievement generally refers to the extent to which a student has attained their educational goals, often measured through grades, test scores, and other assessments (Brophy, 2019). In Mathematics, academic achievement is critical as it serves as a predictor of success in higher education and various professional fields (Mayer, 2021). Despite its importance, students' academic achievement in Mathematics has been a persistent concern, particularly in developing countries like Nigeria. The incidents of low students' academic performance in the SSCE examinations, either in WAEC or NECO examinations have been so huge and alarming that they

should not be ignored any more. The failure of school children to develop mastery of the subject can therefore be seen as a failure of the society to groom the learners to become useful players in their emerging society. This is unacceptable in an emerging society in the modern technological age.

Factors contributing to low academic achievement in mathematics include inadequate teaching methods, lack of resources, and students' negative attitudes towards the subject (Adebisi, 2020). These issues are compounded by socio-economic challenges that limit students' access to quality education. In recent years, the integration of audio-visual materials in educational settings has garnered significant attention due to their potential to enhance students' learning experiences and academic performance. Audio-visual materials, a subset of instructional materials, include videos, animations, and interactive simulations that cater to different learning styles and can significantly enhance students' understanding of complex topics (Olusola & Rotimi, 2022). Thus, the use of audio-visual materials in teaching Mathematics has been shown to have both positive and negative impacts on students' academic achievement in senior secondary schools.

On the positive side, these materials can improve students' motivation, engagement, and comprehension (Akpan & Umoren, 2018). However, over-reliance on audio-visual aids without proper integration into the curriculum can lead to superficial learning and decreased critical thinking skills (Usman, 2021). The use of these materials is particularly crucial in the teaching of complex subjects such as mathematics, where visual and auditory stimuli can help clarify abstract concepts and engage students more effectively. The traditional chalk-and-talk method of teaching has been criticized for its inability to cater to the diverse learning needs of students (Adebisi, 2020). In contrast, audio-visual materials provide a multi-sensory learning experience that can improve comprehension and retention (Mayer, 2021). These materials include videos, animations, interactive simulations, and graphical presentations, which can simplify complex mathematical concepts and make learning more interactive and enjoyable (Olusola & Rotimi, 2022).

Research indicates that students exposed to audio-visual materials perform better academically compared to those taught through conventional methods (Akpan & Umoren, 2018). This is particularly relevant in mathematics education, where visual aids can demystify difficult topics and stimulate interest in the subject. Moreover, the adoption of technology in education aligns with global educational trends and the Nigerian government's policy on the use of information and communication technology (ICT) in schools (Federal Ministry of Education, 2019). Despite the recognized benefits of audio-visual materials, there is a notable lack of empirical studies investigating their impact on students' academic achievement in mathematics within the Yola Education Zone of Adamawa State, Nigeria. This gap in research limits the ability of educators and policymakers to make informed decisions about incorporating these materials into the teaching process.

In addition, Yola Education Zone in Adamawa State faces unique educational challenges, including inadequate teaching resources and low student performance in mathematics (Usman, 2021). This study therefore aimed to address these issues by examining how audio-visual materials can enhance students' understanding and achievement in mathematics. By providing empirical evidence on the effectiveness of these materials, the study sought to inform educational practices and policies in the region. Thus, the study investigated the effect of audio-visual materials on the academic achievement of senior secondary school students in Mathematics within Yola Education Zone of Adamawa State, Nigeria.

Problem Statement

The persistent low academic achievement in mathematics among senior secondary school students for the past five years (2018 to 2022), in Yola Education Zone of Adamawa State, Nigeria, poses a significant challenge to educational stakeholders. Traditional teaching methods, particularly the lecture method, have been widely criticized for their inability to engage students effectively and enhance their understanding of complex mathematical concepts. Despite the potential benefits of integrating audio-visual materials into the teaching process, there is a notable lack of empirical studies examining their impact on students' academic performance in this region. Audio-visual materials, which include videos, animations, and interactive simulations, have been shown to

improve students' engagement, motivation, and comprehension in various educational contexts. However, the specific effects of these materials on students' academic achievement in mathematics within the Yola Education Zone remain underexplored. This gap in research limits the ability of educators and policymakers to make informed decisions about the adoption and implementation of audio-visual tools in the mathematics curriculum.

Understanding the impact of audio-visual materials on students' academic achievement in mathematics is crucial for addressing the educational challenges in the Yola Education Zone. This study seeks to investigate whether the integration of audio-visual materials can significantly improve students' understanding and performance in mathematics, providing empirical evidence to inform teaching practices and policy decisions in the region. Therefore, this study is carried to determine the effects of using audio-visual materials on the students' Mathematics achievement in senior secondary schools in Yola Education Zone of Adamawa State. The study was carried out with the view to making the students improve their Mathematics learning and produce a sustainable greater achievement in the subject. Specifically, the study sought to:

1. determine the students' mean academic achievement when taught Mathematics with the use of audio-visual materials and those taught without it in senior secondary schools in Yola Education Zone, Adamawa State;
2. determine the effect of audio-visual materials on academic achievement of secondary school students based on gender;
3. examine the differences in academic achievement between students taught Mathematics with the use of audio-visual materials and those taught without using audio-visual materials in Yola Education Zone, Adamawa State.

Research Questions

The following research questions were raised for this study:

1. What is the academic performance of students when taught Mathematics using audio-visual materials and those taught without using audio-visual materials in Senior Secondary Schools in Yola Education Zone, Adamawa State?
2. What is the academic achievement, based on gender, of students taught Mathematics using audio-visual materials in Senior Secondary Schools in Yola Education Zone?
3. What is the academic performance of students taught mathematics before and after instructional treatment with the use of audio-visual materials in senior secondary schools in Yola Education Zone, Adamawa State?

Research Hypotheses

The research null hypotheses raised for the study have been tested at the 0.05 level of statistical significance. They include the following:

$H_0$1: There is no significant difference between the Post-test achievement of students taught Mathematics with the use of audio-visual materials (Experimental, X_1) and those taught without using audio-visual materials (Control, X_2) in Yola Education Zone, Adamawa State.

$H_0$2: There is no significant effect of the Post-test academic achievement of male and female students taught Mathematics with the use of audio-visual materials in senior secondary schools in Yola Education Zone.

$H_0$3: There is no significant difference between the Pre-test and Post-test academic achievement of students taught Mathematics with the use of audio-visual materials in senior secondary schools in Yola Education Zone, Adamawa State

METHODOLOGY

This study adopted the quasi-experimental non-randomized pretest, post-test and control group design. The study involved an estimated population of 15,565 students which comprised 8,452 male and 7,113 female students that offered Mathematics were involved. There were two SSS II classes from two selected schools used as the Experimental Group (X_1) while two other SSS

II classes from other schools made up the Control Group (X_2). All the four schools were selected to avoid communication between the students from different instructional treatments. The simple random sampling techniques was used for drawing samples from the four schools selected from the four Local Government Areas. The sample size of the study consisted of 160 senior secondary (SSS II) students in the selected schools. These comprised 65 females and 95 males.

The instrument was titled: Mathematics Achievement Test (MAT) and subjected to face and content validity by experts. The instrument was also pilot tested in two senior secondary schools in Numan Education Zone that were outside Yola Education Zone. The scores of participants in the even group and that of the odd group were subjected to reliability analysis using Guttmann split-half techniques. The analysis gave a reliability index of 0.80. Student in the experimental group were been taught by the teacher using instructional materials; while the control group was taught their Mathematics topics in the designed curriculum without the use of instructional Materials in their lessons.

At the preliminary stage, permission was sought from the sampled schools, with the intact class used. Training and orientation of two Mathematics teachers who were to serve as research assistants in the study were done at this stage; which also included the pre-test. The Treatment Stage was instructional treatment phase which lasted for four weeks. The control group was not subjected to instructional materials being used in the lessons. The experimental group was taught with the use of a film projector to assist students' learning. The treatment in each group lasted four weeks. The post-test stage was when the students were subjected to the test at the end of the instructional treatment period. The research assistants were then appreciated and disengaged to carry on with their normal school teaching. The data collected from both pre-test and post-test were statistically analysed on the basis of the mean and standard deviation for answering the research questions while the null hypotheses were tested using t-test analysis at 0.05 level of significance.

RESULTS

The results are presented in Table 1–6, based on the research questions and hypotheses.

Research Questions

Research Question 1`: What is the difference in academic achievement between students taught Mathematics using audio-visual materials and those without use of audio-visual materials in senior secondary schools in Yola Education Zone, Adamawa State?

To answer this research question, the students' academic achievement in the post test administration was used for analysis. The results analysed were the achievement scores recorded. The mean scores of the Experimental Treatment group (X_1) were compared with those of the Control Treatment group (X_2). The analysis result is summarized in Table 1.

Table 1: Descriptive Statistics of Students' Post Test Achievement of Students in Experimental Group and those in Control Groups

Treatment Group	N	$\bar{X}$	Mean Difference	Std. Deviation	Std. Error Mean
Experimental (x1)	80	60.09	11.35	12.2785	1.3729
Control (x2)	76	48.74		13.9765	1.6032

The results in Table 1 show that the academic achievement of students taught Mathematics with the use of audio-visual materials earned a higher academic achievement score than their counterparts taught without using audio-visual materials. There was a margin of difference of 11.35% in favour of the students taught Mathematics with the use of audio-visual materials to support the teaching process.

Research Question 2: What is the academic achievement based on gender of students taught Mathematics using audio-visual Materials in senior secondary schools in Yola Education Zone?

Table 2: Descriptive Statistics of the Post Test Achievement Scores of Male and Female Senior Secondary School, Taught Mathematics Using Audio-Visual Materials in Yola Education Zone, Adamawa State

Source of variation	N	$\bar{X}$	Mean Difference	Std. Deviation	Std. Error
Males	45	59.44		11.8140	1.7611
			-1.47		
Females	35	60.91		12.9805	2.1941

Results in Table 2 show that the students' post-test performance on the basis of gender had male students achieving 59.44% while the female students achieved 60.91. The female students had a higher mean score than the male students. The female students got 1.47% greater than the male students. It can however be seen that the difference was very narrow between the two sets. There was a narrow gain of 1.47% in favour of females after the instructional treatment in which audio-visual materials were used for teaching for four weeks. Evidently, there was almost an equal academic achievement of Mathematics learning between the genders when audio-visual materials were used for teaching Mathematics in the class.

Research Question 3: What is the academic achievement of students before and after instructional treatment when taught Mathematics with the use of audio-visual Materials in senior secondary schools in Yola Education Zone, Adamawa State?

The data for this analysis is presented in Table 3, the data is analysed to provide a profile of students' academic performance between the pre-test and post-test administrations of the Mathematics Achievement Test (MAT) designed for the study. The teaching of Mathematics for the Experimental Treatment group was done with the teachers using audio-visual Materials to support the teaching. A summary of individual performances for the Experimental treatment (X_1) is recorded in Appendix V (a). To answer the research question, a descriptive statistical analysis is applied. The descriptive statistics is summarized in Table 3.

Table 3: Descriptive Statistics of Pre-test and Post-test Academic Achievement of Senior Secondary School Students Taught Mathematics Using Audio-Visual Materials in Yola Education Zone, Adamawa State

Source of variation	N	$\bar{X}$	Mean Difference	Std. Deviation	Std. Error Mean
Pre- test	80	40.59		12.6518	1.4145
			-19.50		
Post test	80	60.09		12.2797	1.3729

Results in Table 3 shows that the students' post-test performance was greater than the pre-test performance. The students were taught Mathematics by the teachers using audio-visual materials to help the learning of the students. The mode of teaching was according to the lesson plan developed by the teacher for each lesson. There was a gain of 19.50% above the achievement before instructional treatment. This could indicate that there was a positive effect of instruction on students' knowledge in Mathematics.

Hypothesis Testing

The hypotheses tested in the present study were aimed at investigating some critical aspect of the study that are here presented accordingly. In the first place, samples in the study comprised students placed in the two research groups. One group was the Experimental (X_1) and the other was the control (X_2). The experimental X_1 was given instructional treatment where audio visual materials were used to support instruction. The Control X_2 was taught mathematics without using audio- visual materials to assist instruction. Each hypothesis was focused on finding out if there was significant difference in academic performance between the different groups involved in the hypothesis. All hypothesis were tested at 0.05 level of statistical analysis. The analyses are here presented accordingly.

$H_0$1: There is no significant difference between the Post-test academic achievement of student taught Mathematics with the use of audio-visual material (X_1 Treatment) and those taught Mathematics without the use of audio-visual materials (X_2 Treatment) both of them were analysed using t-Test Analysis.

The Academic achievement result is recorded. A descriptive statistical analysis of the performances is presented in Table 1. The statistics shows that the students exposed to Mathematics instruction where audio-visual materials used got mean academic achievement of 60.9% while those not given instruction with using such materials got only 48.74%. a t-Test analysis was then conducted on the result data to find out if the difference in performances was statically significant. The result of the t-test analysis is summarized in Table 4 below:

Table 4: t-test Analysis of Students Post –test Academic Achievement of those Taught Mathematics with the use of Audio-Visual Materials and those without using Audio-visual Materials in the study Area.

Instructional Treatment	X̄	Mean Difference	Std. Error Difference	df	t	Sig. (2-tailed)
Experimental ($X_{1)}$ Group	60.09	11.35	2.104	154	5.315	.000*
Control (X_2)	48.74					

*Significant, $p < .05$.

The results show that there exists a significant difference between the students taught Mathematics with the use of audio-visual materials and those without using audio – visual Materials ($t = 5.315$; $df = 154$: $p < 05$). The result shows that there was a significant gain in academic achievement in favour of the students in the experimental treatment who were taught Mathematics with the support of audio–visual materials for the same cause the student taught without using audio–visual materials got a significant lower achievement than their counterparts.

$H_0$2: There is no significant difference in the academic achievement of students, by gender, when they are taught Mathematics with the use of audio-visual materials the data were analysed using t-Test in senior secondary schools in Yola Education Zone, Adamawa State.

The students' academic performance of interest is reported in analysis found in Table 2. It shows means scores as males: 59.44%and females: 60.91%. The t-test analysis is here summarized in Table 5 below:

Table 5: Summary of t-test Analysis of Senior Secondary School Students' Academic Achievement of those Exposed to Mathematics Instruction with the Use of Audio-Visual Materials based on Gender in Yola Education Zone, Adamawa State

Source	$\bar{X}$	Mean Difference	Std. Error Difference	df	t	Sig. (2-tailed)
Males	59.44	-1.47	2.780	78	-0.529	.0.0736**
Females	60.91					

Significant; p > .05.

The results in Table 5 shows that there is no significant difference between the male and female students' mean academic achievement after being taught Mathematics with the use of audio-visual materials in senior secondary schools in the zone (t = 1.47; df = 78; p > .05). It is then shown here that when instructional materials comprising audio-visual materials were used for teaching Mathematics, both the male and female students achieved equivalently in academic performance.

$H_0$3: There is no significant difference between the pre-test and post-test academic achievement of senior secondary school students taught Mathematics with the use of audio-visual materials in Yola Education Zone, Adamawa State.

The hypothesis was designed to establish if there was a significant difference between the pre-test and post-test performances of the students taught Mathematics with the use of instructional materials that were audio-visual materials. The pre-test and post-test academic achievements of students under this instructional treatment are recorded. The data was analysed using t-test analysis. The t-test analysis focused on performances of the students taught Mathematics with the use of instructional materials (Experimental Treatment, X_1) in both the pre-test and post-test academic achievements. The analysis is summarized and presented in Table 6 below:

Table 6: Summary of t-test Analysis of Pre-test and Post test Academic Achievement of Students Taught Mathematics with the Use of Audio- Visual Materials in Yola Education Zone, Adamawa State

Source	$\bar{X}$	Mean Difference	Std. Error Difference	df	t	Sig. (2-tailed)
Pre-test	40.59	-19.50	2.780	158	-9.892	.0.000*
Post-test	60.09					

*Significant; p<0.5

The results in Table 6 shows that there was a significant difference between the pre-test and post-test academic achievement of the students (t = 9.89; df = 158; p < .05). The analysis thus reports that the students' mean academic achievement after instructional treatment where audio-visual materials supported teaching was significantly greater than that before these materials used.

DISCUSSION

The present study was focused on implications of the use of audio-visual materials to teach Mathematics in the senior secondary school class. The outcome generally shows that students exposed to Mathematics instruction where audio-visual materials are used will significantly get a far better academic achievement than their counterparts to whom such Materials are not used. This is

in line with some earlier revelations of scholars on the applications of instructional resources to enhance students learning (Natoli, 2016; Usman, 2016; Roblyer, 2013). On a similar note, Zainab (2017) points out that using audio-visual Materials in instruction is a dependable way for teachers to overcome students' learning difficulties and bring about effective academic achievement in their learning.

This result is in line with an earlier argument of David (2020) in favour of the use of audio-visual materials in instruction. The argument arose from the Gestalt theoretical consideration that emphasized that learning takes place faster when the whole situation in question is perceived. The theoretical consideration of the Gestalists also align with the views of Emmanuel (2016) that audio-visual materials enable students to relate parts of the topic to a foundation for understanding how relevant clues would facilitate learning comprehension. An important implication of the use of instructional materials in teaching is that found as students' improvement in academic performance.

The application of using audio-visual materials to teach Mathematics has been shown to be highly beneficial to students irrespective of their gender. The present study has shown that both boys and girls in the senior secondary school class can learn Mathematics at equivalent levels when the audio-visual materials are employed in teaching. This is clearly with the position of Usman (2016), which explains that instructional resources applied in teaching enable student academically achieve effectively in their learning of mathematical Sciences in the school. By the use of audio-visual materials, the teacher falls on the path of making the students learn effectively because those Materials facilitate clarity of meaning, support learning retention and thus ease achievement. It is thus an important task for the mathematics teacher to map out strategies for getting and using teaching Materials that will also carry along all shades of learners in class.

Results of the study have also shown that students taught Mathematics using audio-visual materials produce a greatly higher academic achievement than when these Materials are not applied in the teaching process. This implies that in an effort to produce a wider success rate of students in Mathematics, teachers have a responsibility to cater for and use relevant audio-visual materials for teaching topics that may pose challenges to students' understanding. This is in line with another thought that when learners are to only listen and hear facts from the teacher, forgetting may occur because there are not resources like teaching Materials to support the process of meaningful learning (Abolade, 2016). According to the author, what students are taught will be more easily retained when resources are used to support instruction because that is what can foster assimilation of meaningful learning.

This study posits that by participating in new forms of activities involving the use of audio-visual materials, a student has the opportunity of active participation that would lead to an increased individual learning potential. This has reinforced the primary goal that schools should enjoy an improvement of teaching that would lead to more effective learning of Mathematics in their lessons. Similarly, the use of audio-visual Materials is declared as critical in enabling learners' development by creating new forms of understanding Mathematics pedagogy that bring about self-confidence in the (Roth, 2013). When the student has self-confidence, he/she has the belief and trust to lean effectively from the mathematics lessons carried out in the class. The dusty of the teacher is therefore using those opportunities that help the individual learner to build confidence in the learning process. This is where the application of instructional resources such as using audio-visual materials becomes to be an important area to be explored. Thus, in the wisdom of researchers, teaching goal should be focused on opening opportunities that clarify mathematical concepts or problems so that the learner is able to develop confidence and achieve the learning objectives (Emmanuel, 2016; Roth, 2013).

CONCLUSION AND RECOMMENDATION

The study has shown that the use of audio-visual materials in teaching, greatly enhances the learning of Mathematics in the secondary school class. This application is a means of enabling the student to see clearly the meaning of the concepts and principles that the teacher would teach. This leads to students earning a greater academic achievement in the study of Mathematics. The

study has shown that there will be significant increase in the students' examination achievement when teachers apply instructional Materials in their teaching process. This increased performance benefits all students irrespective of gender. This has been shown in the fact that there arises no significant difference in the performance of boys and girls when audio-visual Materials are used to support the teaching process. This is mainly due to the fact that such materials enable learners to get more clarification that make it easy for them to see the message of the teaching content.

The research also helps to point out that audio-visual materials application goes beyond the use of cardboard sheet diagrams and chalk board illustrations during teaching. Thus, based on these findings, the study concludes that audio-visual materials have significant effect on the academic achievements of Mathematics students in senior secondary schools in Yola Education Zone of Adamawa State. Based on this, the study recommends the following:

1. Government and school proprietors should endeavour to see that the institution is provided with necessary audio-visual Materials that can make teachers carry out their teaching process having to face challenges from lack of facilities.
2. The availability of a sustainable power supply will enable the teacher engage instructional materials that require electricity to use.
3. The school management and Parents Teachers Association (PTA) should look into the possibility of repairing broken down instructional materials (audio-visual Materials) in the school with a view to reactivating and upgrading provision of such items.
4. The State Ministry of Education should organize annual seminars and workshops that will sensitize Mathematics teachers on the use of appropriate audio-visual Materials that would enhance the effective teaching and students' learning process.

REFERENCES

Abolade, A. O. (2016). *Overview and management of audio-visual media and resource centre in Nigeria*. (Paper presented at ARMTI for communication specialists). Ilorin: October 22, 2004.

Adebisi, A. O. (2020). Challenges of the traditional teaching method in contemporary education. *Journal of Educational Research and Review*, *15*(3), 112-125.

Akpan, V. I. & Umoren, G. E. (2018). Impact of audio-visual aids on the teaching and learning of chemistry in secondary schools in Akwa Ibom State, Nigeria. *International Journal of Educational Research*, *6*(1), 35-42.

Brophy, J. E. (2019). *Motivating students to learn* (4th ed.). Routledge.

Chianson, M. M., Kurumech, M. S. & Obida, J. A. (2019). Effects of cooperative learning strategy on students' retention in circle geometry in secondary schools in Benue State, Nigeria. *American Journal of Science and Industrial Research, 6*(2), 29 – 43.

David, S. M. (2020) *Impact of audio-visual aids on students' performance in mathematics in senior secondary schools in Imo State*. (Unpublished M.Ed. Thesis: Lagos University Lagos, Nigeria).

Emmanuel, N. K. (2020). *Effects of audio-visual instructional materials on students' performance in mathematics in senior secondary schools in Ogun State.* (Unpublished M.Ed. Thesis: University of Nigeria, Nsukka, Nigeria).

Federal Ministry of Education. (2019). National policy on information and communication technology (ICT) in education. Abuja: Federal Government of Nigeria.

Kajuru, Y. K. & Kauru, A. I. (2017). Effect of constructivist teaching strategy on gender in learning of addition and subtraction skills at primary school level*. Journal of Studies in Science and Mathematics Education, 1*, 82-88.

Mayer, R. E. (2021). *Multimedia learning* (3rd ed.). Cambridge University Press.

Natoli, C. (2018). *The importance of audio-visual materials in teaching and learning*. Retrieved from www.helium.com/channels/224-early-childhood-ed

Olusola, A. O. & Rotimi, A. K. (2022). The role of audio-visual materials in enhancing students' academic performance in mathematics. *Journal of Educational Technology*, *8*(2), 89-101.

Roblyer, V. (2018). *Learning theories and instructional processes*. Spring field Publisher Ltd, Owerri, Nigeria, pp. 262-268.

Roth, W. (2013). Theoretical study of learning in co-teaching. *Journal Researching Science Teaching, 39*(3), 20-53.

Usman, L. A (2016). The effect of indoor and outdoor instructional methods on academic achievement of JSS Integrated Science in Zaria Local Government Area, Kaduna State*. Journal of Science and Mathematics Education, 1*(1), 66-73.

Usman, Y. (2021). Educational challenges in Adamawa State: A focus on mathematics education in secondary schools. *African Journal of Educational Studies*, 14(2), 57-74.

Zainab, A. T. (2017). *Effects of audio-visual instructional materials on students' academic performance in Mathematics in senior secondary schools in Kwara State.* (Unpublished M.Ed. Thesis, University of Nigeria, Nsukka, Nigeria).