

# ZAJESE

## ZARIA JOURNAL OF EMPIRICAL STUDIES IN EDUCATION EFFECT OF MULTIMEDIA RESOURCES ON INTEREST, PERFORMANCE AND RETENTION IN MATHEMATICS CONCEPTS AMONG UPPER-BASIC SECONDARY SCHOOL STUDENTS IN ZARIA, KADUNA-STATE

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### ABSTRACT

The study determined the effect of multimedia resources on interest, performance and retention in mathematics concepts among upper-basic secondary school students in Zaria, Kaduna-State. This study had four objectives, four research questions and four null hypotheses. Quasi-experimental research design was adopted for the study. The population of the study was 2,766 Basic II mathematics students in Zaria with a sample size of 200 via 2-intact classes. Mathematics Performance Test (MPT) and Mathematics Interest Questionnaire (MIQ) were used as instruments for data collection. The instruments were validated by 3 senior lecturers in the Department of Science Education and Measurement and Evaluation from ABU, Zaria. The two instruments were reliable with 0.83 and 0.73 coefficient values. Men, standard deviation, t-test and Mann-Whitney U tests were used for analyses. The results revealed that there is significant difference in the performance of students taught using multimedia resources and those taught using conventional method in mathematics in upper-basic schools in Kaduna State ( $p = 0.00 < 0.05$ ), no significant difference between the retention ability level of students ( $p = 0.20 < 0.05$ ), there is significant difference between the interest level of students ( $p = 0.00 < 0.05$ ), and there is significant difference in the performance of male and female mathematics students ( $p = 0.00 < 0.05$ ). It was recommended among others that Kaduna state Government should make multimedia resources available and adequate for teaching and learning of mathematics in upper basic schools in Kaduna State, among others.

**Keywords:** Multimedia Resources, Performance, Interest, Retention, Mathematics

### INTRODUCTION

Mathematics is generally recognized as a basic aspect of the school curriculum as well as necessary skill for national development. It fosters logical reasoning, critical thinking, and mathematical problem-solving skills that are indispensable for success in science, technology, engineering, and mathematics (STEM) throughout the world. However, in Nigeria including Kaduna State, the performance of upper basic school {Basic 7–9} students in mathematics is still worrisome (Oga et al., 2024; Mulang, 2021). A major factor contributing to this underperformance is students' waning interest in the subject and their failure to retain mathematical concepts over time, typically due to the abstract and teacher-centered character of mathematics training (Saha et al., 2024; Mazana, et al., 2019). To solve these issues, educationists have

urged the inclusion of multimedia materials into mathematics teaching. Multimedia tools such as interactive movies, simulations, animations, digital games, and audio-visual presentations combine many modalities of representation (text, voice, visuals, and motion) to produce rich, engaging learning experiences (Khamparia & Pandey, 2017). These resources have the potential to simplify complicated mathematical concepts, give visual representations, and accommodate various learning styles, so making mathematics more accessible and entertaining for students. When used effectively, multimedia can ignite curiosity and boost learners' interest, which is a crucial motivational component in academic performance (Davidovitch & Dorot, 2023).

Poor academic performance in Mathematics continues to be a serious concern in upper basic schools. Many students struggle to master key

mathematical concepts such as fractions, percentages, and algebraic expressions, typically scoring below average on classroom tests and public examinations (Mazana, et al., 2019). This low performance has been attributed to issues such as abstract information delivery, over-reliance on rote memorization, and lack of compelling instructional materials. Multimedia resources have been demonstrated to boost students' academic performance by providing visual and interactive representations of mathematical problems, allowing learners to create meaningful connections and improve comprehension. For instance, animations can illustrate fraction division visually, helping students to learn difficult processes more readily. Studies by Adamu et al. (2018), and Ukamaka and Egolom (2023), have showed significant improvements in test results among students taught utilizing multimedia-based teaching methodologies compared to those taught with conventional approaches. Hence, integrating multimedia can serve as an effective intervention to increase student performance in Mathematics.

Retention, the capacity to recall and apply previously learned material, is particularly critical in Mathematics because each new concept often relies on past knowledge. Unfortunately, traditional teacher-centered methods, which emphasize repetition and memorization, typically fail to encourage long-term retention. Students taught using such methods usually forget earlier concepts, leading to poor advancement and inadequate academic foundations (Schwartz, 2015). Multimedia resources, such as video courses, interactive tutorials, and instructional simulations, allow repeated exposure to concepts in multiple formats, which helps reinforce learning and increase memory recall. Vicuna and Vicuna (2024) discovered that students exposed to digital simulations retained mathematical methods better than those taught via textbook explanations. Similarly, Abdulrahman et al. (2020) observed that students retained and applied mathematical concepts more accurately weeks after teaching when multimedia technologies were employed during the class.

Interest is another critical variable influencing mathematics learning. Students who are interested in mathematics are more likely to participate actively, persevere in problem-solving, and pursue further studies in STEM-related disciplines. Unfortunately, many Nigerian students develop anxiety and aversion toward mathematics due to uninspiring teaching methods and lack of real-life application (Mazana et al., 2019). Multimedia resources such as interactive games, simulations, and audio-visual materials have been shown to stimulate students' curiosity and enhance motivation. According to Smith (2018), the use of animations and gamified content significantly increased students' interest in mathematics classes. Similarly, Davidovitch and Dorot (2023) emphasized that multimedia-supported instruction encourages learners to become active participants rather than passive recipients, fostering a more positive attitude toward learning. Thus, promoting interest through engaging instructional approaches is a practical way to tackle persistent disinterest and underperformance in mathematics.

Equally important is retention, which refers to the ability of students to remember and apply previously learned mathematical concepts over time. Retention is critical in mathematics since each topic often builds upon prior knowledge. Traditional rote memorization and abstract instruction frequently fail to support long-term retention, whereas multimedia resources can provide interactive and repetitive exposure to concepts, aiding memory consolidation (Vicuna & Vicuna, 2024; Schwartz, 2015). Despite the promising benefits of multimedia in mathematics education, many upper basic schools in Kaduna State still rely heavily on conventional teaching methods that limit student participation and creativity. Moreover, studies on the combined effect of multimedia resources on students' interest and retention in mathematics are limited, especially within the Nigerian context. This gap underscores the need for a focused investigation into how multimedia tools can be effectively used to enhance students' interest, retention, and ultimately, mathematics performance.

Therefore, this study seeks to examine the effect of multimedia resources on interest, performance and retention in mathematics concepts among upper-basic secondary school students in Zaria, Kaduna-State.

### Statement of the Problem

The main problem addressed in this study is the limited use of multimedia resources in the teaching of Mathematics at the upper basic level in secondary schools in Zaria, Kaduna State. Despite the proven benefits of multimedia in enhancing student interest, performance, and retention, many teachers rely on conventional, abstract teaching methods that contribute to poor concentration, low engagement, and inconsistent academic performance among students. This issue is further compounded by teachers' lack of awareness or training on multimedia tools, inadequate availability of such resources, poor maintenance, and limited access due to financial or institutional constraints. Consequently, students struggle with retaining and recalling mathematical concepts, which negatively affects their overall academic achievement. This study, therefore, aims to investigate how the integration of multimedia resources can improve students' interest, performance, and retention in Mathematics.

### Objectives of the Study

The objectives of the study are to:

1. compare the performance of students taught mathematics concept using multimedia resources and those taught using conventional method in upper-basic schools in Kaduna State.
2. determine the retention level of mathematics students taught using multimedia resources in upper basic schools in Kaduna State.
3. compared the interest level of students taught using multimedia resources and those taught using conventional resources in upper-basic schools in Kaduna State.
4. examine the difference in performance of male and female Mathematics students taught using multimedia resources in upper basic schools in Kaduna State.

### Research Questions

The following research questions were raised to guide the conduct of this study:

1. What is the difference in performance of students taught mathematics concept using multimedia resources and those taught using conventional method in upper-basic schools in Kaduna State?
2. What is the difference in retention ability level of students taught mathematics using multimedia resources in upper basic schools in Kaduna State?
3. What is the difference in the interest level of students taught using multimedia resources in mathematics from those taught using conventional resources in upper-basic schools in Kaduna State?
4. Is there any difference in performance of male and female Mathematics students taught using multimedia resources in Upper Basic Schools in Kaduna State?

### Null Hypotheses

The following hypotheses were tested at a 0.05 level of significance:

- HO<sub>1</sub>: There is no significant difference in the performance of students taught using multimedia resources and those taught using conventional method in mathematics in upper-basic schools in Kaduna State.
- HO<sub>2</sub>: There is no significant difference between the retention ability level of students taught mathematics using multimedia resources in upper-basic schools in Kaduna State.
- HO<sub>3</sub>: There is no significant difference between the interest level of students taught using multimedia resources and those taught using conventional resources in upper-basic schools in Kaduna State.
- HO<sub>4</sub>: There is no significant difference in the performance of male and female mathematics students taught using multimedia resources in upper basic schools in Kaduna State.

### METHODOLOGY

This study adopted a quasi-experimental research design, specifically the non-equivalent pre-test, post-test control group design, to determine the effect of multimedia

resources on students' interest, retention, and performance in mathematics in upper basic schools in Kaduna State. The choice of this design allowed the researcher to study the impact of the treatment (use of multimedia resources) on a group of students (experimental group) while comparing their outcomes with a control group taught using conventional methods. The study population consisted of 2,766 Upper Basic II mathematics students in public schools across Zaria, Kaduna State. A sample of 200 students from two intact classes in two comparable coeducational schools was selected. One class was assigned to the experimental group (120 students) and the other to the control group (80 students).

Two validated instruments, reviewed by three senior lecturers from the Departments of Science Education, Measurement and Evaluation, and English at Ahmadu Bello University (ABU), Zaria, were used for data collection: the Mathematics Performance Test (MPT) and the Mathematics Interest Questionnaire (MIQ). The MPT assessed students' knowledge of mathematical concepts before and after instruction, while the MIQ measured changes in students' interest levels. The reliability of the instruments was established using Pearson Product Moment Correlation Coefficient (PPMC) and Cronbach Alpha, yielding coefficients of 0.83 and 0.73, respectively. Data collection was conducted in three phases: a pre-test phase to establish baseline data, a treatment phase where the experimental group received instruction using multimedia tools such as videos and interactive presentations while the control group followed the conventional method, and a post-test phase to evaluate learning outcomes. The study was conducted over a period of six weeks, during which the concepts of fractions was taught. In addition to the pre-test and post-test, a post-post-test was administered two weeks after the intervention to measure students' retention of the concepts taught. Data were analyzed using mean and standard deviation for research questions, and t-tests and Mann-Whitney U tests for hypotheses testing at a 0.05 level of significance.

## RESULTS

**Table 1: t-test analysis of difference in the performance of students taught using multimedia resources and those taught using conventional method**

Study Groups	N	Mean	Std. Dev	df	t-cal	P	Decision
Experimental	120	24.92	2.25		198	14.36	0.000 Significant
Control	80	19.23	2.96				

*Significant at  $p < 0.05$*

Table 1 presents the result of an independent samples t-test comparing the academic performance of students taught Mathematics using multimedia resources (experimental group) and those taught using conventional methods (control group). The experimental group recorded a higher mean score ( $M = 24.92$ ,  $SD = 2.25$ ) compared to the control group ( $M = 19.23$ ,  $SD = 2.96$ ). The calculated t-value was 14.36 with a p-value of 0.000, which is less than the 0.05 significance level. This result indicates a statistically significant difference in performance between the two groups. Hence, the null hypothesis is rejected. The findings suggest that the use of multimedia resources significantly enhanced the performance of students in Mathematics compared to conventional teaching methods in upper basic schools in Kaduna State.

**Table 2: t-test analysis on the mean difference of retention ability level of students in both groups**

Study Groups	N	Mean	Std. Dev	df	t-cal	p	Decision
Experimental	120	24.92	2.25		198	1.29	0.20 Not Sign.
Control	80	24.50	2.40				

*Significant at  $p < 0.05$*

The result of the t-test analysis in Table 2 compares the retention ability of students taught mathematics using multimedia resources (experimental group) and those taught using the conventional method (control group). The experimental group had a slightly higher mean score ( $M = 24.92$ ,  $SD = 2.25$ ) than the control group ( $M = 24.50$ ,  $SD = 2.40$ ). However, the calculated t-value of 1.29 with a p-value of 0.199 is greater than the 0.05 level of significance. This indicates that there is no statistically significant difference in retention ability between students taught using

multimedia resources and those taught through conventional means. Therefore, the null hypothesis is retained, suggesting that while multimedia may slightly enhance retention, the difference was not significant enough in this study to conclude a strong effect.

**Table 3: Mann Witney U-test analysis on the mean difference of interest level of students in both groups.**

Variable	N	Mean	SD	Df	U-test	p-value	Decision
Interest Multimedia	120	2.9	.67	198	1.03	.000	Sign.
Interest Conventional	80	2.0	.61				

The analysis of results in Table 3 showed the difference between the interest level of students taught mathematics concepts using multimedia resources and those taught using conventional resources in upper-basic schools in Kaduna State. The hypothesis was rejected because the sig. value of .000 is less than 0.05 level of significance. This therefore means that there are differences between the interest of students taught mathematics using multimedia resources and those taught using conventional resources in upper-basic schools in Kaduna State.

**Table 4: t-test analysis on the difference in the performance of male and female students in experimental group.**

Study Groups	N	Mean	Std. Dev	df	t-cal	p	Decision
Male	55	16.67	2.01	118	-18.23	0.000	Significant
Female	65	24.92	2.25				

*Significant at  $p < 0.05$*

The result of the independent samples t-test presented in Table 4 shows a significant difference in the performance of male and female Mathematics students taught using multimedia resources. Female students had a higher mean score ( $M = 24.92$ ,  $SD = 2.25$ ) than their male counterparts ( $M = 16.67$ ,  $SD = 2.01$ ). The calculated t-value was -18.23 with a p-value of 0.000, which is less than the 0.05 level of significance. This indicates that the difference in performance between male and female students is statistically significant. Therefore, the null hypothesis stating that there is no significant difference in performance between male and female students taught with multimedia resources is rejected. This suggests

that female students benefited more from the use of multimedia resources in learning Mathematics at the upper basic level in Kaduna State.

## DISCUSSION

Based on the findings of the study, the following were discussed. This study found out that the performance of students taught mathematics using multimedia resources was significantly better than that of students taught using conventional methods ( $p = 0.000$ ). This finding corroborates the conclusions drawn by Davidovitch and Dorot (2023), who found that students' motivation and performance improve significantly when teaching methods shift from traditional approaches to more interactive, multimedia-based strategies. In a similar vein, Saha et al. (2024) reported that multimedia instruction helps clarify difficult mathematical concepts, leading to improved academic success and sustained interest among learners. The dynamic and multisensory nature of multimedia materials ensures better retention and transfer of knowledge compared to traditional lecture methods. Furthermore, Irvine (2020); Mazana, et al. (2019) find out that students' attitudes and interest towards mathematics are heavily influenced by the instructional methods employed, with interactive and visual teaching tools contributing to more positive learning experiences. Teachers who use multimedia resources are more likely to capture and sustain students' attention, enhance conceptual understanding, and build confidence in mathematical problem-solving.

The finding that there is no significant difference between the retention ability level of students taught Mathematics using multimedia resources and those taught using conventional methods in upper basic schools in Kaduna State ( $p = 0.20 > 0.05$ ) indicates that while multimedia resources may enhance interest and immediate performance, they do not necessarily lead to superior long-term retention compared to traditional teaching methods. This result aligns with the findings of Vijayalakshmi and Reddy (2020), who noted that while multimedia improves short-term engagement, it does not automatically guarantee better long-

term memory retention unless reinforced with continuous practice. Similarly, Mogboh and Okeke (2019) found that retention depends more on revision strategies and the frequency of content exposure than on the instructional method alone. In their study, Ayithey et al. (2023) reported that both multimedia and conventional methods can support retention when paired with effective reinforcement techniques such as repetition and summarization. Liu and Lahoz (2024) also argued that learners' retention abilities are more influenced by personal study habits and learning styles than by the nature of the instructional materials. Furthermore, Albus et al., (2021) emphasized that while multimedia creates excitement during lessons, the novelty effect may wear off over time, thus requiring additional instructional support for lasting memory retention. Therefore, although multimedia may enrich the learning environment, it may not inherently provide a significant advantage in students' ability to retain mathematical concepts unless combined with consistent review and application strategies.

Students showed more interest when teaching them mathematics using multimedia resources than when using conventional resources in upper basic schools in Kaduna State at ( $p = .000$ ). This finding is in line with the report of Filgona, et al., (2020) who reported that, the differential chance of spending energy on one set of stimuli rather than another is referred to as interest as a crucial component in students' progress in mathematics. It's a type of intrinsic motivation in which you do something because it's good fundamentally. Performance and interest are two components of motivation that play important roles in learning and human achievement in general. Lack of interest can lead to poor academic performance and even dropping out. 'Ideally,' writes Jerome Bruner, "interest in the content to be learnt, rather than such external goals as grades or subsequent competitive advantage, is the ideal stimulus to learning (Sanders, 2019). Learning motivations must be avoided from becoming passive, they must be founded as much as possible on the arousing of interest in what is to be learnt, and

they must be kept broad and diverse in expression' in an age of rising spectatorship.

The finding that there is a significant difference in the performance of male and female mathematics students taught using multimedia resources in upper basic schools in Kaduna State ( $p = 0.00 < 0.05$ ) highlights the influence of gender on how students benefit from technology-enhanced instruction. Several recent studies have shown that female students often demonstrate better academic outcomes when exposed to multimedia learning environments. For example, Efa and Frimpong (2023) observed that female students showed greater improvement in Mathematics performance due to their higher engagement and focus during multimedia-assisted lessons. Similarly, Adamu et al. (2018); Abdulrahman, et al. (2020) reported that female learners responded more positively to interactive video content and visual aids, leading to better understanding and retention of mathematical concepts. In contrast, Haleem et al. (2022) found that male students, though often more confident with technology, were sometimes more distracted during multimedia sessions, which affected their learning outcomes. Furthermore, Dele-Ajayi, (2018) emphasized that female students often display stronger motivation and persistence when using structured multimedia tools, while males preferred more competitive or game-based content. A recent study by Heo and Toomey (2020) also confirmed that multimedia instruction significantly improved female students' test scores more than their male counterparts due to their methodical approach to digital content. These findings suggest that while multimedia resources are effective overall, their impact may vary by gender, underscoring the need for inclusive and gender-sensitive instructional designs in mathematics education.

## CONCLUSION

Based on the findings, the study concluded that multimedia resources improve the teaching and learning of mathematics in upper basic schools in Kaduna State. The multimedia resources also retains students learning experiences in mathematics which implies that students will

continue to understand mathematics better when teachers use multimedia resources to teach in upper basic schools in Kaduna State.

### RECOMMENDATIONS

Based on the findings of this study, the following recommendations were made:

1. Kaduna state government should make multimedia resources available and adequate for teaching and learning of mathematics in upper basic schools in Kaduna State.
2. Using multimedia resources to teach mathematics should be encouraged by the secondary school authorities because it is better than conventional resources.
3. To make students more interested in learning mathematics, multimedia resources should be encouraged to be used by the teachers in upper basic schools in Kaduna State.

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