Effectiveness of Multimedia Courseware Based Instruction on Senior School Students' Retention in Linear Equation Word Problems

Ridwan Enuwa Mohammed[1]*, Khadijat Saka Ameen[2], Ayuba Bala[3]

[1,2] Department of Science Education University of Ilorin, Ilorin, Nigeria

[2] Department of Science Education Federal University of Kashere, Gombe State, Nigeria

*Corresponding Author: mohammed.re@gmail.com

ABSTRACT

The increasing popularity of Multimedia courseware in education aims to address the challenges posed by abstract concepts and the consequent underachievement of students. It is also relevant to consider the limitations of working memory resources during multimedia courseware based instruction of abstract concepts in order to evaluate irrelevant factors that create unwanted cognitive drain and make retention difficult. The study investigated the effects of multimedia courseware based instruction on senior school students' achievement and retention in linear equation word problems in Mathematics. The study adopted a quasi-experimental research design. In Gombe State Nigeria, 120 students (69 males and 51 females) were selected from three co-educational senior schools allocated either into experimental group or a control group. The results of the study indicated that students exposed to multimedia courseware based instruction achieved and retained linear equation word problems than their counterparts who were exposed to conventional teaching method. There was significant difference between the mean retention scores of male and female students exposed to multimedia courseware based instructions which the result is in favor of female students. High, medium and low achievers' students exposed to multimedia courseware based instructions retained the concept of linear equations involving word problems and high scorer retained better. Based on the above findings it was recommended that multimedia courseware based instruction should be used in teaching and learning of Mathematics as it was found capable of improving students' retention in linear equation word problems in Mathematics.

INTRODUCTION

Science and Technology have a very important place in the development of society because they have changed almost every aspect of life from education, agriculture, business industry, transportation to modern culture. Mathematics is the forerunner and queen of science and technology and an indispensable single element in modern societal development (Agah, 2020). The basis of science and technology, which is a prerequisite for development of a nation, is Mathematics. Mathematics fosters science and technological development and facilitates the formation of sensible, thoughtful, and productive citizens (Kratvitz, 2013). Mathematics introduces learners to different ways of solving problems and guides them to make discoveries,

analyze and interpret their experiences (Salman et al, 2011). Certain qualities encouraged by mathematical knowledge are reasoning skills, creativity, abstract or spatial reasoning, critical thinking, problem-solving skills, and even effective communication skills (Zhou & Deng, 2017). Mathematics is the framework of all creations, without which the world cannot move. Whether cook or farmer, carpenter or mechanic, businessman or scientist, everyone needs Mathematics in everyday life. This shows the importance of Mathematics in nation building. Recognizing the important role of Mathematics in nation building, government of the Federal Republic of Nigeria has made Mathematics a compulsory subject in primary and secondary education in Nigeria (NERDC, 2013). Mathematics is also an important requirement for admission into the universities in Nigeria.

Algebra is one of the content areas in Mathematics and has its application in physics and other applied sciences. It is taught to students at the secondary school level, it also continues up to university. Knowledge of algebra is so vital that its utility is needed as a basis for further study in other branches of Mathematics, and students without a good knowledge of algebra would be challenged when studying calculus, geometry, statistics and probability (Adu et al, 2017). Algebra is widely recognized as one of the most difficult areas in Mathematics at secondary and tertiary level of education (Jupri et al, 2014). There are many concepts in the field of algebra that are taught to students in our Nigerian classroom. Linear equations word problem is one of the area in the algebraic process and one of the dreaded topic for students.

Mathematics education is undergoing a transformation aimed at improving instruction quality and learner retention. This shift is happening alongside advancements in information technology and the development of new research methodologies in mathematics education. In the current information age, the integration of technology and computer-oriented education systems is prompting educators to explore alternative teaching methods that enhance retention, applicable from elementary schools to universities. The widespread adoption of technology in schools has necessitated curriculum restructuring and changes in teaching and learning approaches worldwide. Consequently, learning environments have evolved, incorporating student-centered, active learning methods along with computer-assisted teaching, including the use of Multimedia Courseware technology. This innovative approach is flexible, user-friendly, and cost-effective, especially when supported by mobile learning. It can effectively support the teaching of various subjects such as Mathematics, Physics, and Chemistry in the 21st century and beyond, including the post-pandemic era.

Research studies have examined the effectiveness of multimedia-based instruction on student achievement and retention in various subjects. For example, Prabakaran and Saravanakumar (2020) found that high school students using interactive e-content modules demonstrated improved achievement and retention in Mathematics compared to traditional teaching methods. Similarly, Nwanze et al. (2018) discovered that multimedia-integrated lessons had a significant positive impact on students' achievement and retention in Chemistry. Gambari et al. (2014) observed that video-based multimedia instruction enhanced secondary school students' achievement in Biology but resulted in slightly lower retention compared to conventional teaching methods. Anunobi et al. (2016) conducted a study on web-based instruction in Basic Technology among junior secondary school students in Nigeria, finding that students exposed to web-based instruction retained concepts better than those taught using conventional methods. Furthermore, the effectiveness of web-based instruction was consistent across different ability levels.

In summary, the integration of multimedia-based instruction in education has shown promise in improving achievement and retention among students in various subjects. These findings support the utilization of multimedia courseware as an effective teaching tool in the modern era of education.

Statement of problem

Students' poor performance in Mathematics, particularly on linear equation word problem, has worried Parents, Teachers, Mathematics educators and researchers. this was revealed from the results of observations

and interviews at a secondary high school in Gombe State, Nigeria. Although the concept of linear equation word problems ranges from junior secondary school to senior secondary school levels, reports from research have also shown that secondary school students have had difficulty in solving simple linear equation word problems, students also make several errors in solving linear equation word problem (Adu, Assuah, & Asiedu-Addo, 2015; Samuel, Mulenga & Angel, 2016; Wati, & Fitriana, 2018; Bukari, 2019). The Chief Examiners Reports of the West African Examinations Council (WAEC) highlighted that majority of candidates who sat for the West African Senior School Certificate Examination (WASSCE) in Mathematics in May/June find it difficult to answer questions on word problems in Mathematics, in particular translating word problems into mathematical statements (WAEC, 2012, 2013, 2017 & 2020). The causes of these poor performance have been attributed to several factors such as use of traditional teaching methods (Salman & Ameen, 2014; Arop, Mbon, Ekanem, Ukpabio, Uko & Okon, 2020). Hence, it leads to inability of students to retained or recall what has been learned and apply for future use.

It is obvious that Mathematics concepts are usually being taught by using abstract examples and words when taught using the traditional or conventional instructional methods. This type of teaching, requires high intellectual abilities to acquire the subjects taught, which creates high pressure on the students, causing them to lose confidence and reduce their capacity. Integrating multimedia courseware based instruction in Mathematics classroom can provide an effective learning environment for students to improve their mathematical skills by facing real-world conditions to make the abstract concepts concrete and clear. In this way, the students can learn in a meaningful and sustainable way and are much better prepared for their future educational life such as university education or even their professional life. It is believed that this integration will help eliminate problems such as misunderstandings related to some fundamental concepts that arise during the teaching and learning of Mathematics. Therefore, the present study examined the effectiveness of multimedia courseware based instruction on senior school students' retention in linear equation word problems.

Research Questions

The study raised and answered the research questions: (1) Is there any difference in the academic achievement of students taught linear equation word problems using multimedia courseware based instruction and those taught using conventional method?; (2) Is there any difference in the retention of students taught linear equation word problems in Mathematics using multimedia courseware based instruction and those taught using conventional method?; (3) Is there any difference in the retention mean gain scores of male and female students taught linear equation word problems in Mathematics with multimedia courseware based instruction?; (4) Is there any difference in the retention mean gain scores of high, medium and low scoring students taught linear equation word problems in Mathematics?; (5) Is there any interaction effect among multimedia courseware, students' gender and score levels on students' retention in linear equation word problems in Mathematics?

METHODS

The study adopted a quasi-experimental research design. It used a pre-test, post-test, non-randomized, non-equivalent control group involving a $2 \times 2 \times 3$ factorial matrix. Two levels of independent Variable (experimental and control groups), two levels of gender (male and female), and three levels of retention (high, medium and low) were investigated on students' retention in linear equations involving word problems in Mathematics. The factorial design is shown in Table 1.

The population for the study comprised all the senior secondary school students in Gombe, Gombe State, Nigeria. The target population for the study was all senior secondary school students in SS II in Gombe, Gombe State, Nigeria. The choice of SS II students is based on the fact that a linear equation word problems is an SS II topic of Mathematics scheme in the Mathematics Curriculum (NERDC, 2011). Intact class of 120

students (69 Males and 51 females) were involved in the study from two purposively selected senior secondary schools in Gombe, Gombe State, Nigeria. The schools were purposively selected because of the availability of functioning computer laboratory and also being co-educational. The instruments for the study are Mathematics Achievement Test on Linear Equation Word Problems (MAT), which was used for collecting data and Treatment instrument was the Multimedia Courseware on Linear Equation Word Problems in Mathematics (MCLEWPM).

Table 1. The Layout Representation of the $2 \times 2 \times 3$ factorial Design

Group	Gender	Score Levels		
		High (1)	Medium (2)	Low (3)
Experimental	Male Y	AY1	AY2	AY3
Group (A)	Female X	AX1	AX2	AX3
Control Group (B)	Male Y	BY1	BY2	BY3
	Female X	BX1	BX2	BX3

The Multimedia Courseware package on Linear Equation Word Problems in Mathematics (MCLEWPM) was developed by the researcher and the computer programmers where the researcher designed the content of the package and the programmer designed the website and the android application. The package was designed to be used in a website and an android application software. It is designed to teach students with the assistance of teacher to teach Linear Equation Word Problems in Mathematics and provides some multiple choice objective questions and offer assessment to monitor the students' progress. Each of the lessons were presented by the web through interactive mode. The web package is designed using HTML, CSS and JavaScript technology. HTML and CSS was used to create the user interface (UI) which is the part the students interact with while using the application. The Logic part of it which is includes assessment and score calculation is done using JavaScript programming language. The mobile application is created and packaged using a Vue.js and Capacitor respectively. Vue.js is employed to design and create the user interface while it is converted into an installable application in the students' phones using a library called Capacitor.js. The Multimedia Courseware package were validated by four Mathematics Education and Educational Technology experts. The multimedia courseware was edited based on the comments, criticism and suggestions that were given by the experts.

Mathematics Achievement Test on Linear Equation Word Problems (MAT) is divided into two sections (section A & section B). Section A is to obtain the bio-data of the respondents which include: Gender, class and test number. Section B of the instrument consisted of five (5) essay questions on linear equation word problems in Mathematics. The instrument was designed by the researcher in line with the Mathematics curriculum. Mathematics Achievement Test on Linear Equation Word Problems (MAT) were validated by four experts in Mathematics Education. One expert from the department of science education, University of Ilorin, one expert in examination development department, in West African Examination Council (WAEC) and two experienced Mathematics teachers (of at least ten years of working experience) in Gombe, Gombe State, Nigeria. The validated MAT was tested for reliability using Pearson Product Moment Correlation (PPMC), which yielded 0.78 at 0.05 alpha level of significance, indicating that the MAT is very reliable with good construct validity.

All the groups (experimental and control) were given pretest before the treatment. Experimental group was exposed to the multimedia courseware based instruction while the control group was exposed to conventional teaching method. The posttest was administered on the groups after two weeks of treatments. The retention test was administered on the groups after three weeks of posttest. Mean and standard

deviation were used to analyze the research questions while *t*-test and Analysis of Covariance (ANCOVA) was used to analyze the hypotheses.

RESULTS AND DISCUSSION

Result

Research Question One: Is there any difference in the academic achievement of students taught linear equation word problems using multimedia courseware based instruction and those taught using conventional method?

The achievement of experimental and control groups of Mathematics students who were given linear equation word problems is compared in Table 2. The pretest mean scores for the experimental and control groups were 39.57 and 38.42, respectively, but the post-test mean scores for the experimental and control groups were 64.98 and 59.23, respectively. In addition, the mean gain scores for the experimental and control groups were 25.41 and 20.81, respectively. The mean gain scores of the experimental and control groups differed by 4.60, with the experimental group having a higher mean gain score.

Table 2. Expressions of the Mean Gain Scores of Students in the Experimental and Control Groups

Groups	N	Pretest		Posttest		$\bar{X}$ Mean Gain Score
		$\bar{X}$	SD	$\bar{X}$	SD	
Experimental	60	39.57	18.65	64.98	16.72	25.41
Control	60	38.42	11.99	59.23	13.31	20.81

Research Hypothesis One: There is no significant difference between the senior school students' achievement in linear equation word problems when taught using multimedia courseware and those taught using conventional method.

The results of the data analysis for research hypothesis I, which was tested using a *t*-test, are shown in Table 3. According to the results of the analysis of hypotheses I, the t-value ($t_{(118)}$ = 2.08, $p<0.05$) was significant at the 0.05 alpha level. This implies that there was a significant difference in the achievement between the experimental and control groups, with the experimental group outperforming the control group. As a result, hypothesis I was rejected, meaning that using multimedia courseware based instruction enhanced students' achievement in linear equation word problems in Mathematics.

Table 3. The t-test Analysis of the Significant Differences in the Achievement between the Experimental and Control Groups

Groups	N	Mean	SD	*df*	*t*	Sig. (2-tailed)
Experimental	60	64.98	16.72			
				118	2.08	0.039
Control	60	59.23	13.31			

p< 0.05

Research Question Two: Is there any difference in the retention of students taught linear equation word problems in Mathematics using multimedia courseware based instruction and those taught using conventional method?

Table 4 shows the mean and standard deviation of the posttest and retention scores of the experimental and control groups. The result reveals that the mean and standard deviation of the posttest and retention scores of the experimental group are 64.98 $\pm$16.72 and 67.62 $\pm$14.55 respectively. This gives a mean retention of 2.64 in favor of the retention test. Similarly, the mean and standard deviation of the posttest and

retention scores of the control groups are 59.23 $\pm$13.31 and 58.60 $\pm$13.11 respectively. This gives a mean loss of -0.63 in favor of the posttest. Also from the result, it can be seen that the mean retention scores of the experimental (67.62) and control (58.60) groups differed by 9.02, with the experimental group having a higher mean retention score.

Table 4. Expressions of the Mean Retention Scores of Students in the Experimental and Control Groups

Groups	N	Posttest		Retention		$\bar{X}$ Mean Retention Score
		$\bar{X}$	SD	$\bar{X}$	SD	
Experimental	60	64.98	16.72	67.62	14.55	2.64
Control	60	59.23	13.31	58.60	13.11	-0.63

Research Hypothesis Two: There is no significant difference between the senior school students' retention in linear equation word problems in Mathematics when taught using multimedia courseware based instruction and those taught using conventional method.

The results of the data analysis for research hypothesis II, which was tested using a *t*-test, are shown in Table 5. According to the results of the analysis of hypotheses II, the t-value ($t_{(118)}$ = 3.57, $p<0.05$) was significant at the 0.05 alpha level. This implies that there was a significant difference in the retention of the experimental and control groups, with the experimental group retaining better than control group. As a result, hypothesis II was rejected, meaning that using multimedia courseware based instruction enhanced students' retention in linear equation word problems in Mathematics.

Table 5. The t-test Analysis of the Significant Differences in the Retention between the Experimental and Control Groups

Groups	N	Mean	SD	*df*	*t*	Sig. (2-tailed)
Experimental	60	67.62	14.55			
				118	3.57	0.001
Control	60	58.60	13.11			

p< 0.05

Research Question Three: Is there any difference in the retention mean gain scores of male and female students taught linear equation word problems in Mathematics with multimedia courseware based instruction?

Data collected for this research question was on the male and female students who were taught using the multimedia courseware and analyzed using mean and standard deviation as shown in Table 6.

Table 6. Mean Scores and Standard Deviations of Male and Female Students' Retention in Linear Equation Word Problems Taught Using Multimedia Courseware

Groups	N	Posttest		Retention		$\bar{X}$ Mean Retention Score
		$\bar{X}$	SD	$\bar{X}$	SD	
Male	36	71.33	10.46	72.28	10.68	0.95
Female	24	55.46	19.83	60.63	16.87	5.17

Table 6 reveals the mean and standard deviation of the retention scores of male and female in the experimental group who were taught linear equation word problems. From the result, it can be seen that the mean score and standard deviation of the posttest and retention scores of Male are 71.33 $\pm$10.46 and 72.28

$\pm$10.68. The mean gain is 0.95 in favor of the male retention score. Similarly, the mean and standard deviation of posttest and retention scores of female students are 55.46 $\pm$19.83 and 60.63 $\pm$16.87. The mean gain is 5.17 in favor of the female retention score. Also the result reveals that the female students retained more from the use of multimedia courseware based instruction to teach linear equation word problems, as they had a higher mean score than the male students, with a retention mean gain score difference of 4.22 in their favor.

Research Hypothesis Three: There is no significant difference in the retention of male and female senior school students in linear equation word problems in Mathematics when taught using multimedia courseware based instruction.

The results of the data analysis for research hypothesis III, which was examined using the t-test, are shown in Table 7. The t-value ($t_{(58)}$ = 3.28, $p<0.05$) was statistically significant at the 0.05 alpha level, as indicated in Table 8. This finding demonstrates that male and female students who were taught linear equation word problems using multimedia courseware based instruction retained significantly differently, with female students outperforming male students, and it answers research question 3. As a result, hypothesis III was rejected, implying that multimedia courseware assist female students' more than male students.

Table 7. t-test Analysis of Significant Differences in Male and Female Students' Achievement in the Experimental Group

Gender	N	Mean	SD	df	t	Sig. (2tailed)
Male	36	72.28	10.68			
				58	3.28	0.002
Female	24	60.63	16.87			

$p < 0.05$

Research Question Four: Is there any difference in the retention mean gain scores of high, medium and low scoring students taught linear equation word problems in Mathematics?

In answering research question four, the posttest scores of high, medium and low scoring students in experimental group were analyzed using mean and standard deviation as shown in Table 8.

Table 8. Post-test and Retention Mean Scores and Standard Deviation of Score Levels of Experimental Group Students' Achievement

Group	N	Posttest		Retention		Mean Gain Score
		Mean	SD	Mean	SD	
Low Level	6	36.33	11.34	37.83	9.45	1.50
Medium Level	24	60.83	12.83	61.21	6.10	0.38
High Level	30	74.03	12.15	78.70	6.41	4.67

Table 8 shows the mean and standard deviation of the posttest and retention scores of low, medium and high level experimental group. The result revealed that the posttest and retention scores of low level students in experimental group are 36.33 $\pm$11.34 and 37.83 $\pm$9.45 respectively while the mean gain score is 1.50 in favor of the low level retention score. Similarly, the mean score for the posttest and retention scores of medium level students in experimental group are 60.83 $\pm$12.83 and 61.21 $\pm$6.10 respectively while the mean gain is 0.38 in favor of medium level students in retention score. Also the mean score for the posttest and retention scores of high level students in experimental group are 74.03 $\pm$12.15 and 78.70 $\pm$6.41

respectively while the mean gain is 4.67 in favor of high level students in retention scores. It can also be seen from the result that there is difference between posttest scores of the three levels. The high level students have the highest mean retention score of 78.70 followed by the medium level with 61.21 while the low level students have the least mean retention score of 37.83.

Research Hypothesis Four: There is no significant difference in the retention of high, medium and low scoring students when taught linear equation word problems in Mathematics using multimedia courseware based instruction.

The data was analyzed using ANCOVA. The F-value ($F_{(2,56)}$ = 47.98, $p<0.05$) was significant since the p-value of 0.00 was less than the 0.05 alpha level, as shown in Table 9. This indicates that there was a significant retention difference between the low, medium, and high scorers' students when they were taught linear equation word problems utilizing multimedia courseware, with the high scorers' students retaining the most, and it provides the answer to research question 4. As a result, hypothesis IV was disproved, implying that using multimedia courseware significantly enhanced high-scoring students' retention in linear equation word problems in Mathematics.

Table 9. Summary of the Analysis of Covariance of Significant Differences in Students' Retention in the Experimental Group for Low, Medium and High Scorers

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	10775.865[a]	3	3591.955	117.609	.000
Intercept	4428.129	1	4428.129	144.988	.000
Posttest	782.773	1	782.773	25.630	.000
Score Levels	2930.868	2	1465.434	47.982	.000
Error	1710.318	56	30.541		
Total	286807.000	60			
Corrected Total	12486.183	59			

a. R Squared = .863 (Adjusted R Squared = .856)

Research Question Five: Is there any interaction effect among multimedia courseware, students' gender and score levels on students' retention in linear equation word problems in Mathematics?

Table 10. Description of the Interaction Effects of Multimedia Courseware, Gender and Score Levels of Students' when taught Linear Equation Word Problems

Gender	Score Levels	Mean	Std. Deviation	N
Male	High	78.59	6.759	22
	Medium	63.85	5.565	13
	Low	43.00	-	1
	Total	72.29	10.676	36
Female	High	79.00	5.732	8
	Medium	58.09	5.356	11
	Low	36.80	10.183	5
	Total	60.62	16.865	24
Total	High	78.70	6.407	30
	Medium	61.21	6.100	24
	Low	37.83	9.453	6
	Total	67.62	14.548	60

Research Hypothesis Four: There is no any significant interaction effect among multimedia courseware, gender and scoring levels on students' retention in linear equation word problems in Mathematics.

Table 11 shows how the data were analyzed on interaction effects among multimedia courseware, gender and scoring levels using ANCOVA. According to the results of the analysis, the F-value ($F_{(2,53)} = 1.335$, $p > 0.05$) was not significant because the p-value of 0.272 was more than the 0.05 alpha level. This finding demonstrates that there was no significant interaction effect of treatment on gender or scoring levels when students were taught linear equation word problems, and thus answers research question five. As a consequence, hypothesis five was retained, meaning that gender and level of scoring (moderating variables) had no effect on multimedia courseware (the treatment). As a result, the adoption of multimedia courseware as a major treatment had a considerable impact on students' retention.

Table 11. ANCOVA of Interaction Effects of Treatment on Gender and Score Levels of Students' when taught Linear Equations Word Problems

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	10858.915[a]	6	1809.819	58.946	.000
Intercept	4036.964	1	4036.964	131.484	.000
Pretest	635.451	1	635.451	20.697	.000
Gender	15.495	1	15.495	.505	.481
Score Levels	2547.608	2	1273.804	41.488	.000
Gender * Score Levels	81.993	2	40.996	1.335	.272
Error	1627.268	53	30.703		
Total	286807.000	60			
Corrected Total	12486.183	59			

a. R Squared = .870 (Adjusted R Squared = .855)

Summary of Findings

The following are the summary of findings of the study: (1) There was a significant difference in the achievement of students taught linear equation word problems using multimedia courseware based instruction and those taught with conventional method and the result is in favor of those taught using multimedia courseware; (2) There was a significant difference in the retention of students taught linear equation word problems using multimedia courseware based instruction and those taught with conventional method and the result is in favor of those taught using multimedia courseware; (3) There was a significant difference in the retention of male and female students taught linear equation word problems using multimedia courseware based instruction and the result is in favor of the female students; (4) There was a significant difference in the retention between high, medium, and low scorers' students when they were taught linear equation word problems using multimedia courseware, with the high scorers' students outperforming the others; and (5) There was no significant interaction effect on gender and score levels of students' retention when taught linear equation word problems using multimedia courseware.

Discussion

The students taught with multimedia courseware based instruction performed better than those taught with conventional method. This finding is in agreement with the finding of Anunobi et al (2016) which showed that students' taught with web-based instructional package performed better than those taught within traditional method. It also agrees with the finding of Gambari et al (2014) which shows that students taught biology using video-based multimedia instruction performed better than their colleagues in the conventional teaching method.

The study reveals that students taught linear equation word problems in Mathematics using multimedia courseware based instruction had a better retention than those taught with conventional teaching method. The finding is in agreement with the finding of Anunobi et al (2016) which revealed that students taught basic technology using web-based instruction had a better retention than those taught with traditional method. It also agrees with the finding of Nwanze et al (2018) who revealed that multimedia had improved students' achievement and retention in Chemistry. The result also agreed with the finding of Prabakaran and Saravanakumar (2020) who showed that the students boost their achievement and retention ability through the interactive e-content module of learning when compared with the conventional method of teaching. In contrary, this finding is not in agreement with the result of the finding of Gambari et al (2014) which showed that students in conventional teaching method had better retention than those taught under multimedia instruction.

The study also revealed that female students retained better than males when taught linear equation word problems in Mathematics using multimedia courseware based instruction. This finding is in agreement with the finding of Jayanthi and Srinivasan (2015) which showed that female students performed better than male in Mathematics. It also agrees with the findings of Mazana et al (2020) who reported that gender difference exists in students' performance in Mathematics in favor of females. In contrary, the study is not in agreement with the result of Anunobi et al (2016) which revealed that male and female students retained the concept of basic technology equally.

The study also showed that high scoring students have the highest retention ability followed by the medium and low scoring students respectively when taught linear equation word problems in Mathematics using multimedia courseware based instruction. This finding is not in agreement with the result of Anunobi, Gambari, Abdullahi and Alabi (2016) which revealed that Web-Based instruction (WBI) improved students' abilities levels irrespective of high, medium and low levels.

CONCLUSION

This study critically examined the concepts of linear equation word problems in post basic secondary school Mathematics in a rapidly changing world. From the authors' point of view, there is still a large gap in the area of teaching and learning Mathematics that needs to be bridged. Innovative technology with multimedia, courseware-based guidance seems to be the answer. According to this study, instruction based on multimedia courseware improved students' achievement and retention on linear equation word problems in Mathematics, particularly among males and high scoring students. This means that multimedia study material-based instructions will have an impact on students' learning and teaching outcomes, especially in Mathematics. In addition, the nature of multimedia courseware which involved the use of words and moving images, reduced the abstract nature of the subject, making it easier for students to understand and interact with the content materials. As a result, multimedia courseware based instruction in Mathematics is a successful learning tool and a major improvement over traditional or conventional Mathematics instruction.

Recommendations

Based on the findings and conclusion of this study, the following recommendations were made (1) Teachers should adopt the multimedia courseware based instruction because it is a student's centered and user friendly learning strategy that engages the students; (2) All educational stakeholders in the education industry should see multimedia courseware based instruction as an innovation which must be welcomed, supported and its usage sustained in Nigerian Secondary schools; (3) Teacher education programmes in Nigerian tertiary institutions should be improved upon to prepare teachers who can apply innovative approaches (like multimedia courseware) that will promote effective teaching and learning; and (4) Instructional designers and instructional material developers should develop relevant multimedia courseware packages for use within the Nigerian secondary school system.

Implication of the research findings

When multimedia learning materials are introduced in secondary schools, it can help increase students' participation in classroom activities by enhancing confidence and the ability to study Mathematics at will, and teachers as evaluators can observe students who demonstrate these skills. The results of this study also showed that students' retention in Mathematics improved and enhanced their performance.

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