Effects of Animated Instructional Packages on Achievement and Interest of Junior Secondary School Student in Algebra

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Abstract: This study explored the use of animation in the classroom by investigating whether or not students taught with animation will achieve better than recorded teaching. This study adopted non-equivalent control group, quasi experimental design. Eighty (80) Junior Secondary School 2 students (40 males, 40 females) from two co-educational private junior secondary schools in Bwari Area Council of the Federal Capital Territory (in Nigeria) were involved. Gender of the students and availability of functional computers determined the choice of schools hence purposive sampling was used to select six schools that have functional computer laboratories out of which two schools were randomly sampled using simple balloting with replacement. The purposive sampling means the sampling that adequately addresses the purpose of research which means in this case means schools with boys and girls and having functional computer systems. Two instruments were used for this study, namely Algebra Achievement Test (AAT) and Interest Inventory (MII). The findings showed that teaching algebra with animation can enhance achievement and interest of students in algebra. Gender had no significant influence on the performance of students exposed to animation. The implication of these findings is that teachers now have alternative strategy to teach a concept in junior secondary school. Based on the findings, it was recommended that workshops, seminars and conferences should be organized for teachers to implement the findings of this study in the classroom.

Keywords: Animation, Instructional packages, Achievement, Interest

INTRODUCTION

The importance of mathematics in the modern society is overwhelming. The importance of mathematics has long been recognized all over the world, and that is why all students are required to study mathematics at the primary and secondary school levels, whether they have the aptitude for it or not (Ojo, 2015; Adebayo, 2008; Adeleke, 2007). However, despite the importance of mathematics in the Nigerian education system, the students' performances continue to deteriorate year after year. Several reasons have been proffered for the high failure rate in mathematics. Given the options, many students will not offer mathematics (Agwagah, 2013). Agwagah noted that an increasing number of students find it difficult to do well in mathematics

because of the teaching method used in teaching most of the themes are not interesting. In other words, the prime position accorded mathematics in the society is at risk because of persistent poor performance. According to Kurumeh and Achor (2008), the difficulties of students in learning mathematics could be attributed to the approach to which the contents are being presented to the students, the abstractness of mathematical concepts, and poor foundation, among others. Most students, especially, at the Junior Secondary School (JSS) have difficulties in understanding mathematics because of the language of instruction (which is English Language) (Ifeanacho, 2012). Majority of the students who are highly proficient in performing mathematical operations, in solving symbolic problems are less proficient in solving problems when it is algebraic (Iji, Abakpa, & Takor. 2015).

The usefulness and vitality of algebra are generally seen as arising from its concepts and pattern of reasoning as they have been adapted in the attempt to solve ongoing human activities. As good as algebra appears to be solving human problems, the symbols, language and expressions commonly in this branch of have continued to be a source of problems to the students (Odili, 2006). This accounts for why Recorded Conventional Instruction (RCI) was considered as a better option to conventional 'chalk and talk' strategy.

In RCI strategy, the lessons are recorded and students participate in the lesson by listening to the computer and carrying out the activities as directed by the computer. The use of innovative strategies as well as instructional media that will bring meaningful learning of mathematics becomes imperative (Ubah & Uzoechi, 2018; Usman & Ezeh 2011). The method being advocated in this study is the one which involves the use of animated instructional package (AIP).

Animation instruction is the use of computer in the delivery of text materials that appear to move (Yalcinalp, Geban & Ozkan, 2005). This delivery of instruction is computer based. Computer-based instruction (CBI) is a method, which uses computer in learning media, strengthening students' motivation and education process (Kulik, 2013; Serin, 2011; Frenzel, Goetz, Pekrun, & Watt, 2010). CBI may enhance interest and students' achievement in algebra.

Achievement is the result, the successfulness, the extent or ability, the progress in learning educational experiences that the individual indicate in relation with his/her educational learning (Olga, 2008). Achievement in mathematics, which is the focus of this study, is viewed as a very important factor in teaching and learning of mathematics and it refers to students' cognitive achievement and psychomotor skills, which are measured in terms of pass or fail (Adebayo, 2008; Popoola & Ajani, 2011). When achievement is below expectation, it is referred to as under-achievement or poor achievement. When students are successful in examination, they will have the feeling of pride that they made success with their own efforts and skill. Small success can give students sense of achievement. On the other hand, persistent failure in dampens students' interest.

Interest is a zeal or willingness to participate in an activity for which one derives some pleasure (Harbor – Peters, 2002). The influence of interest on students' learning may vary across

gender. Gender has been identified as one of the factors influencing students' interest and achievement in mathematics (Popoola & Ajani, 2011). Gender issues as a factor or variable are not yet skewed to any direction. There are different findings on gender matters, some in favor of males, others in favor of females and sometimes no gender differences are found (Ifeanacho, 2012).

From the foregoing, the researcher considers it necessary to search for an appropriate approach that is student-centered and that can enhance academic achievement and interest in mathematics. Therefore, this study intends to find if animation could be used to improve students' achievement and interest.

Statement of the Problem

Literature is filled with evidence that teachers are using ineffective methods and strategies in teaching mathematics, which among other factors, have contributed to the students' poor achievement in mathematics especially at the Junior Secondary School Certificate Examination (JSSCE) (Usman and Eze, 2011). Research efforts over the years have not only indicated poor performance in mathematics among senior and junior secondary school students but have shown that the traditional teaching method (like chalk-and-talk) has proved ineffective in achieving the desired achievement of students in algebra (Usman and Eze, 2011). The need to find ways of improving students' interest in mathematics is obvious. Teaching strategies have known to influence students' interest in mathematics. Perhaps, the use of AIP with animation can enhance students' interest in algebra. Can the use of AIP affect the academic achievement and interest of male and female JSS students in algebra?

Objectives of the Study

Objectives of this study were to determine the effect of animated and recorded conventional instructional packages on achievement and interest of junior secondary school students in algebra. Specifically, the researcher sought to:

1. Ascertain the mean achievement scores of students taught with animated and recorded conventional instructional packages.
2. Investigate the effect of animated instructional package on junior secondary school students' interest in Algebra.
3. Compare the influence of gender on mean achievement scores of students taught with animation as measured by the Algebra Achievement Test (AAT).
4. Find out the influence of gender on mean interest scores of students taught with animated instructional package.

Research Questions

The following research questions were raised to guide this study.

1. What is the mean achievement score of junior secondary school students taught mathematics using animated instructional and those taught using recorded conventional packages?

2. What is the mean interest score of junior secondary school students taught mathematics using animated instructional and those taught mathematics using recorded conventional packages?
3. What is the influence of gender on mean achievement scores of male and female students taught mathematics with animated instructional package?
4. What is the influence of gender on mean interest scores of male and female students taught mathematics with animated instructional package?

Hypotheses

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

$H0_1$: There is no significant difference in the mean achievement scores of junior secondary school students taught mathematics using animated instructional and those taught using recorded conventional packages.

$H0_2$: There is no significant difference in the mean interest scores of Junior Secondary School (JSS) students taught mathematics using animated instructional and those taught using recorded conventional packages.

$H0_3$: Gender is not significant in the mean achievement scores of male and female junior secondary school students taught mathematics using animated instructional package.

$H0_4$: Gender is not significant in the mean interest scores of male and female junior secondary school students taught mathematics using animated instructional package.

Methodology

Design of the Study

The design of this study is quasi-experimental. Specifically, the non - equivalent control group design involving two groups will be adopted for the study. This design can be used when it is not possible for the researcher to randomly sample the subject and assign them to treatment groups without disrupting the academic programmes of the schools involved in the study (Anaekwe, 2007). This design is considered suitable to conduct this study because intact classes (non-randomized groups) were assigned to the two different techniques of AIP and RCI in order to determine comparative effect on achievement and interest of junior secondary school students in algebra.

Population

The population of the study was made up of all JSS2 students in the 135 private schools in FCT numbering 10,979 (Male=4,899 and Female=6,080).

Sample and Sampling Techniques

The sample for the study was made of 80 students randomly selected from two out of the six schools that met the conditions of having functional computers and allows individual use of the computers in the course of the lesson. The six schools were selected through purposive random sampling technique based on the criteria. The two schools were randomly sampled using simple balloting with replacement. All the students in the two arms of JSS 2 in the selected schools

participated in the study. The two schools are co-educational because gender is a variable. Students in one of the schools were taught using animated instructional package while those from the other school were taught with recorded conventional instructional package.

Instrument for Data Collection

Two instruments for data collection in this study were:

1. Algebra Achievement Test (AAT)
2. Interest Inventory (MII)

The AAT had 40 multiple choice test items developed by the researcher. Each of the multiple choice test instruments had four options (A-D) as possible answers to each question. The items were developed to reflect the concepts treated and in reference to the objectives of the lesson on which the instruction was based. Students were expected to answer the questions in the multiple choice section and the essay section. Each question in the multiple choice section carried one mark while five marks were awarded for each question in the essay section. The questions were drawn from Junior Secondary School Certificate Examination (JSSCE) set by National Examinations Council (NECO).The items measured only the three objectives in the cognitive domain of Bloom's (2014) taxonomy of educational objectives.

The MII was a 24-item interest scale developed by the researcher. It had a four point Likert-type response scale namely: Strongly Agree (SA); Agree (A); Disagree (D); and Strongly Disagree (SD). There were 12 positive and 12 negative statements in MII.

Validation

The 40-item multiple choice with four essay test was validated by five experts. The test items were corrected and modified on the basis of suggestions and recommendations of the experts.

The lesson plans were vetted by two experts in Education. Reliability coefficient of the AAT was determined with Kuder- Richardson formula 21 (K-R 21) and Kendall's coefficient of concordance techniques. The procedure helps to establish the internal consistency of the AAT items. The students' scores were used to compute the coefficient of internal consistency of the AAT which was found to be 0.87 for the multiple choice part. Inter-rater method was used for the essay part and the Kendall's coefficient of concordance was found to be 0.89. Copies of MII filled during trial-testing were scored by the researcher. Cronbach alpha was used to determine the internal consistency of the items and the reliability coefficient. The internal consistency index for interest inventory was found to be 0.75.

Experimental Procedure

The researcher trained the teachers for 10 days while the students were trained for five days. After the training, the researcher observed the teachers in practice session for necessary corrections. The lesson plan covered four weeks on four topics used for the study namely: indices, linear inequalities, probability, and algebraic expressions (expansion and factorization). A total of 16 lesson periods of 40 minutes duration was taught to cover the mathematical concepts used for

the study. Each student was requested to use the computer system to participate in the lesson. The regular mathematics teachers were instructed on how to use the AIP and RCI. On the first day of the experiment, the test instruments – AAT and MII typed in white coloured paper were administered as pre-test to all the students in both the experimental and control groups. After this, both groups were taught mathematics for a period of four weeks. At the end of four weeks, the questions in the AAT were reshuffled, typed in blue-coloured paper and administered to the students as post-test. The scores of both experimental and control groups in pre-test and post-test were computed for data analysis.

Data Analysis and Results

The research questions were answered using means and standard deviation. The hypotheses were tested at 0.05 alpha level using a 2x2 (mode of instruction and gender) analysis of covariance (ANCOVA). The Scientific Package for Social Sciences (SPSS) program of version 17.00 was used to analyze the data.

Research Question 1

What is the mean achievement score of junior secondary school students taught mathematics using animated instructional package and those taught with recorded conventional instruction?

Table 1: Mean and Standard Deviation of achievement scores of students taught mathematics using animated instructional package and those taught with recorded conventional instruction

Approach	Pretest			Posttest		Mean diff.
	N	$\bar{x}$	SD	$\bar{x}$	SD	
AIP	24	10.08	2.98	34.96	12.30	24.88
RCI	56	9.79	3.22	13.11	5.85	3.32

Results in Table 1 show that the group taught mathematics with animated instructional package had a pretest mean of 10.08 with a standard deviation of 2.98 and posttest mean of 34.96 with a standard deviation of 12.30. The difference between the pretest and posttest mean for the group taught with animation is 24.88. The RCI group had a pretest mean of 9.79 with a standard deviation of 3.22 and a posttest mean of 13.11 with a standard deviation of 5.85. The difference between the pretest and posttest mean for the RCI group is 3.32. However, for each group, the posttest means are greater than the pretest means with the animated group having the higher mean difference. This is an indication that animation has some effect on achievement of junior secondary students in mathematics.

Research Question 2

What is the mean interest scores of junior secondary school students taught mathematics using animated instructional package and those taught with recorded conventional instruction?

Table 2: Mean and Standard Deviation of students' interest score taught mathematics using animated instructional package and those taught with recorded conventional instruction

Approach	Pre-interest			Post-interest		Mean diff.
	N	$\bar{x}$	SD	$\bar{x}$	SD	
AIP	24	2.40	0.82	2.52	0.85	0.12
RCI	56	2.55	0.91	2.54	0.93	-0.01

Results in Table 2 show that the group taught using AIP had pre-interest mean of 2.40 with a standard deviation of 0.82 and a post-interest mean of 2.52 with a standard deviation of 0.85. The difference between the pre-interest and post-interest mean interest for the animated group is 0.12. The RCI group had a pre-interest mean of 2.55 with a standard deviation of 0.91 and a post-interest mean of 2.54 with a standard deviation of 0.93. The difference between the pre-interest and post-interest mean for the RCI is -0.01. This result indicates that teaching mathematics using AIP significantly increased interest of the students.

Research Question 3

What is the influence of gender on mean achievement scores of male and female students taught mathematics with animated instructional package?

Table 3: Mean and Standard deviation of achievement scores of the Male and Female students who were taught mathematics with animated instructional package

Gender	Pre-test			Post-test		Mean diff.
	N	$\bar{x}$	SD	$\bar{x}$	SD	
Male	9	9.22	1.64	42.56	14.44	33.34
Female	15	10.60	3.50	30.40	8.37	19.80

Results in Table 3 show the pretest and posttest mean and standard deviations of students who were taught with AIP. The male students had pretest mean achievement of 9.22 and posttest mean of 42.56 while the female students had a pretest mean achievement of 10.60 and a posttest mean of 30.40. The male students had a standard deviation of 1.64 in the pretest and 14.44 in the posttest while the female students had a standard deviation of 3.50 in the pretest and 8.37 in the posttest.

The difference between pretest and posttest means score for the male students is 33.44 while the difference between the pretest posttest means score for the female students is 19.80. However, for both male and female students, the posttest means are greater than the pretest means with the male students having the higher mean difference. This result shows that animation may have influence on achievement of students.

Research Question 4

What is the influence of gender on mean interest scores of male and female students taught with animated instructional package?

Table 4: Mean and Standard Deviation of interest scores of Male and Female students who were taught mathematics with animated instructional package

Approach		Pre-interest		Post-interest		Mean
	N	$\bar{x}$	SD	$\bar{x}$	SD	diff.
Male	9	2.39	0.87	2.53	0.97	0.14
Female	15	2.41	0.81	2.52	0.80	0.11

Results in Table 4 show the pre-interest and post-interest mean scores of male and female students exposed to teaching with the use of AIP. The result shows that the male students had pre-interest mean of 2.39 with a standard deviation of 0.87 and a post-interest mean of 2.53 with a standard deviation of 0.97. The difference between the pre-interest mean and post-interest mean for the male students was 0.14. Result also shows that female students had pre-interest mean of 2.41 with a standard deviation of 0.81 and a post-interest mean of 2.52 with a standard deviation of 0.80. The difference between the pre-interest mean and post-interest mean for the female is 0.11. However, for both male and female students, the post-interest mean scores are greater than the pre-interest scores. This result shows that gender may have some effects on male and female students when exposed to teaching with animation.

Hypothesis 1

There is no significant difference in the mean achievement scores of students taught mathematics using AIP and those taught RCI.

Table 5: Summary of ANCOVA Table of Students in Algebra Achievement Test (AAT)

Source	Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	8920.66	4	2230.16	37.44	.000
Intercept	4374.67	1	4374.67	73.45	.000
Pre Test	1.51	1	1.51	.03	.874
Group	8649.36	1	8649.36	145.21	.000
Sex	397.26	1	397.26	6.67	.012
Group * Sex	775.74	1	775.74	13.02	.001
Error	4467.23	75	59.56		
Total	44317.00	80			
Corrected Total	13387.89	78			

Table 5 shows that with respect to the mean scores of students exposed to AIP and those exposed to RCI, an F-ratio of 145.21, corresponding to Group, is obtained with associated exact probability value of 0.00. Since the associated probability value (0.00) is less than 0.05 set as level of significance, the hypothesis is rejected. Hence, there is significant difference in the mean achievement score of students taught mathematics using AIP and those taught using RCI.

Hypothesis 2

There is no significant difference in the mean interest scores of Junior Secondary School (JSS) students taught mathematics using animated instructional package and those taught with recorded conventional instruction.

Table 6: Summary of ANCOVA Table of Interest Inventory (MII) scores

Source	Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	63.25	4	15.81	1887.08	.000
Intercept	.00	1	.000	.05	.824
Pre Interest	63.14	1	63.14	7535.01	.000
Group	.31	1	.31	36.77	.000
Sex	.00	1	.004	.46	.502
Group * Sex	.004	1	.004	.46	.499
Error	.63	75	.008		
Total	577.30	80			
Corrected Total	63.88	78			

The result in Table 6 shows that with respect to interest mean rating scores of students exposed to AIP and RCI, an F-ratio of 36.77 is obtained with associated exact probability value of 0.00. Since the associated probability value (0.00) is less than 0.05 set as level of significance, the hypothesis which states there is no significant difference in the mean rating scores of students exposed to AIP and RCI is rejected. This means that there is a significant difference in the mean interest ratings of students taught with AIP and RCI. Hence, Table 6 shows that the use of computer in teaching is a significant factor in the mean interest rating scores of students who were taught mathematics with AIP and RCI.

Hypothesis 3

Gender is not a significant in the mean achievement scores of male and female junior secondary school students taught mathematics using AIP.

Table 7: Summary of ANCOVA Table of Male and Female Students' scores in Achievement Test (MAT) for those taught mathematics with AIP

Source	Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	833.357	2	416.678	3.305	.057
Intercept	2548.448	1	2548.448	20.214	.000
Pre Test	2.221	1	2.221	.018	.896
Sex	768.569	1	768.569	6.096	.062
Error	2647.601	21	126.076		
Total	32811.000	24			
Corrected Total	3480.958	23			

The result in Table 7 shows that with respect to the mean achievement of male and female students exposed to AIP an F-ratio of 6.10 is obtained with associated probability value of 0.06. Since the associated probability value (0.06) is higher than 0.05 set as level of significance, the hypothesis which states that gender is not significant in the mean achievement of male and female junior secondary school students taught using AIP is not rejected. Thus, inference drawn is that, gender is not significant in the mean achievement scores of students who were taught mathematics with AIP.

Hypothesis 4

Gender is not significant in the mean interest score of male and female junior secondary school students taught mathematics using AIP.

Table 8: Summary of ANCOVA Table of Male and Female Students' mean interest scores of students exposed to animated instructional package (AIP)

Source	Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	16.346	2	8.173	724.478	.000
Intercept	.005	1	.005	.455	.507
Pre Interest	16.346	1	16.346	1448.921	.000
Sex	.005	1	.005	.487	.49
Error	.237	21	.011		
Total	169.304	24			
Corrected Total	16.583	23			

Table 8 shows the mean interest scores of male and female students exposed to AIP. Table 8 shows that the value of significance of F (0.49) on the mean interest scores of students due to gender is 0.49 against the level of P≤ 0.05 level for one degree of freedom. Since the value of F is higher than that of the alpha set at P≤ 0.05, the null hypothesis of no significant difference in the mean interest scores of male and female students exposed to AIP is therefore not rejected. Thus, inference drawn is, gender is not significant in the mean interest scores of students who were taught mathematics with AIP.

Summary of Findings

The major findings of this work are summarized based on the results of the analysis of data.

1. The result of the study showed that the students who were taught mathematics using AIP achieved higher than those taught with RCI.
2. The interest of the students who were taught mathematics using AIP increased while the interest of those who were taught with RCI waned.
3. Male students who were exposed to AIP achieved higher than their female counterparts. However, gender is not statistically significant in achievement.
4. There is a significance difference in the mean achievement and interest scores of students who were taught using AIP and those who were taught with RCI.

Discussion of the Findings

On the basis of result presented, instructional strategy is a significant factor in students' achievement in JSS mathematics. This may generally imply that students' achievement in mathematics is related to the strategy of presenting the concepts.

The mean achievement scores in the post AAT of the students taught with AIP was higher than post AAT mean achievement scores of the students taught with RCI. This shows that the AIP strategy used in teaching mathematics content improved the students' achievement. The difference in achievement of male and female students is higher among the students exposed to AIP. This finding is again confirmed by the result of ANCOVA test, which shows that strategy of instruction is a significant factor on students' achievement in mathematics. As a result, students who were taught mathematics using AIP achieved better than those taught mathematics by using RCI. This may be justified by the fact that the components AIP are highly structured. Moreover, the animation, graphics and sound attract the attention of the students towards learning. The implication is that, mode of instruction used in teaching mathematics is capable of producing effect on students' achievement.

This result is in line with Ubah &Uzoechi (2018), Iji, Abakpa & Takor (2015), Ojo (2015), Ifeanacho (2012), Usman & Eze (2011), Yalcinalp, Geban and Ozkan (2005), Olga (2008), Olusi (2008), and Adebayo (2008). These researchers discovered that exposing students to computer-assisted instruction can improve students' achievement in mathematics. This result also agrees with Usman and Ezeh (2011) and Lodree (2005), whose studies revealed a significant difference in mean achievement scores of students taught with two modes of computer – aided instruction. The result revealed that students exposed to teaching with AIP achieved higher than those exposed to teaching with RCI. This result may have been due to the innovative strategy used to convey mathematical concepts which involves 'hands-on and minds-on' on the part of the students. However, students who were exposed to teaching with RCI may have continued with their rote memorization syndrome of learning mathematics which they were used to. They may not have seen any significant change in their teacher's style of teaching at present compared to what they have been used to in the time past even though computer was introduced.

On the other hand, students exposed to teaching with animation were eager to learn considering the way they participated by asking questions and carrying out activities recommended in the package. This implies that the AIP teaching-learning strategy is efficacious in enhancing students' achievement in mathematics. However, this study is contrary to some studies which claimed that there was no significant difference between AIP and conventional teaching methods (Serin, 2011). The result of this study is contrary to consistent findings in literature on mathematics interest which documented that boys are more interested in mathematics than girls (Frenzel, Goetz, Pekrun & Watt, 2010). The result of this study agrees with Adeleke (2007) whose work showed non-significance in interest of boys and girls exposed to two teaching strategies.

Conclusion

Based on the findings of this study the following conclusions are made. The result of this study provided empirical evidence that computer assisted instruction with animation enhanced students' achievement and interest in more than the use of computer to play recorded lessons . Male and female students who were taught mathematics with AIP performed better than their counterparts that were taught mathematics with RCI. Male students taught mathematics with animation performed higher than female students. The interest of the students who were taught mathematics using AIP increased while the interest of those taught with RCI reduced. Male students who were exposed to AIP w achieved higher than their female counterparts. However, the mean achievement scores of male and female students were not statistically significant. There was a significant difference in the mean achievement scores of students who were taught mathematics using AIP and those taught with RCI. There was a significant difference in the mean interest scores of students who were taught mathematics using AIP and those taught with RCI.

Recommendations

The study recommended among other things that since the use of AIP enhances achievement and interest of students in mathematics:

1. Mathematics teachers should use AIP as one of the strategies to be employed in classroom teaching and learning.
2. Parents should provide computers and animated instructional packages on mathematics topics for their children to use at home after school hours.
3. Seminars and workshops should be organized by State and Federal Ministries of Education for mathematics teachers to enable them to learn how to develop software packages and also learn how to use computer in teaching mathematics.
4. Curriculum planners should embrace and include AIP strategies that will bring about improvement in learning, acquisition of creative thinking, problem solving and performance skills in students into the curriculum

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