

Effect of Improvised Instructional Materials on Students' Achievement and Interest in Longitude and Latitude

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Abstract:-The purpose of the study was to investigate the effect of improvised instructional materials on students' achievement and interest in Longitude and Latitude. The influence of gender on the achievement and interest of the students taught with improvised instructional material (Frame of a Sphere) was also considered. Four research questions and six null hypotheses guided the study. A non-equivalent control group of quasi-experimental design was used for the study. The simple random sampling technique was used to select two schools from Olamaboro Local Government Area of Kogi State, Nigeria. Each of the schools was assigned to control and experimental groups. Two intact classes from each of the schools were used for the study. Two instruments - Longitude and Latitude Achievement Test (LLAT) and Longitude and Latitude Interest Scale (LLIS) were used. Mean and standard deviation were used to answer research questions and ANCOVA was used to test the hypotheses. The study revealed that the use of improvised instructional materials increases the students' achievement and interest. Based on the findings, it was recommended that Mathematics teachers should endeavour to use improvised instructional materials since it enhances the achievement and interest of students.

Keywords: Mathematics, Mathematics Education, Interest, Achievement, Longitude, Latitude, Instructional Materials

I. INTRODUCTION

Mathematics is the life wire of technological advancement. It is an indispensable tool for the development of science and technology. Ekweme and Meremikwu (2013) stated that no nation can hope to achieve any measure of scientific and technological advancement without proper foundation in school mathematics. Salman (2005) as cited in Abakpa and Iji (2011) described mathematics as a precursor of scientific discoveries and innovations.

In spite of the importance and popularity of mathematics to all aspect of human endeavours, researchers show that there is increasingly poor achievement in the subject among secondary school students (Ogunkola, 2000; Awolola, 2010; Abakpa & Iji, 2011; Onyishi, 2014; and Iwendi, 2012). Achievement can be defined as a measure of learner's level of knowledge, skills or performance (Ugwu, 2008). Brown (2005) described achievement as the level of goal accomplishment. Deductively, achievement could be

seen as the successful accomplishment of goals and how students are able to demonstrate their intellectual abilities in mathematical concepts through testing over a period of time. Research report shows that students have consistently low achievement as less than 42% of registered candidates obtained credit pass in mathematics (Uwadiae, 2010). Some aspect of mathematics has posed lots of problems to students' academic achievement. These are: negative indices, application of BODMAS in solving problems, trigonometric relations/values of angles, longitude and latitude, scale drawings and geometry (WAEC Chief Examiners' Report, 2013). Reports from WAEC on students' poor achievement in mathematics continued in the Chief Examiners' Reports from 2010-2014. In 2012, 2013 and 2014, 38.3% 36.57% and 31.28% of the students had credits in mathematics.

Many reasons account for students' poor achievement in mathematics as reported by researchers. These include poor methods of teaching (Harbour-Peters, 2001), poor interest in mathematics (Badmus, 2002; Taylor, 2014; Asheraft & Kirk, 2001). Garvy (2008) emphasized that the students' poor achievement could be as a result of mathematical anxiety. Ifamuyiwa (2006) stressed that some learners personality variables such as gender can be responsible for the students' poor achievement in mathematics. Ogunkola (2000) opined that numerical ability and interest could influence students learning outcomes irrespective of the numerical the instructional strategy used.

In addition, part of the problem is that most teachers still believe that the most effective means of communicating knowledge is via the conventional 'talk and chalk' strategy. With all these problems facing the students, the solution may lie in exposing students to active participation approaches during teaching and learning such as: Target task approach, laboratory method approach, delayed formalization approach, heuristic method (Obodo, 2004); Mathematical games, models and simulation (Agwagah, 2001); and concept mapping technique in teaching mathematical concepts (Imoko and Agwagah, 2006). Obodo (2004) held a view that lack of interest is one of the factors responsible for poor achievement of students in mathematics.

Interest is an important variable in learning because when one becomes interested in an activity, one is likely to be

more deeply involved in that activity (Imoko and Agwagah, 2006). Obodo (2002) defined interest as the attraction which forces or compel a child to respond to a particular stimulus. Interest simply means the likes and dislike or one's reference and aversion (George, 2008). It can be defined as an aspect of affective domain which has to do with ones readiness to like or dislike something. It is a subjective feeling of concentration or persisting tendency to pay attention and enjoy some activity or content. In this sense, interest is a source of motivation.

Moreover, it is advocated that teaching of mathematics concepts should be concretized to enhance the students' motivation in teaching and learning. No course in science and mathematics can be considered as complete without including some practical work. Improvisation and utilization of instructional materials have potentials in teaching of abstract concepts. Gambari & Ghana(2005) emphasized that the use of instructional materials stimulates learning and assist the teachers to properly convey the topic content to the learner in order to achieve better understanding and performance. Afolabi (2008) maintained that achievement of objectives depends largely on the use of improvised instructional materials in mathematics teaching and learning. Offorma (2004) stressed that teachers should be able to produce simple and inexpensive materials such as charts, posters, maps, pictures, drawings and models for effective teaching and learning. Improvisation is the act of using alternative resources to facilitate instructions whenever there is lack or shortage of some specific first hand teaching aids (Eniayeju, 2005). Deductively, it is defined as the act of providing teaching materials from our locality when there is shortage or lack of standard ones. It could also be described as sourcing, selection, deployment of relevant instructional elements of teaching and learning for a meaningful realization of specified educational goals and objectives.

Instructional materials are those resource materials used by mathematics teachers in the classroom. They are resources which both the teachers and students use for the purpose of ensuring effective teaching and learning (Obodo (2004). Azuka (2002) identified the use of instructional materials as a means of improving the teaching and learning in mathematics. Shih, Kno and Liu (2012) developed and evaluated instructional model and learning system and found that the model enhanced mathematical achievement. Joshua (2007) reported that using geometrical globe model for teaching Mathematics concept such as longitude and latitude at senior secondary schools enhanced students' performance.

Generally, the relevance of longitude and latitude and subsequent difficulties experienced by the students at senior secondary level in Nigeria made a study on it pertinent. The concept has been consistent in the Chief WAEC Examiners' Report from 2000 – 2014 as area of students difficulty. This study will thus focus on longitude and latitude.

Having seen the importance of mathematics as the determinant of quality of technological advancement in

addition to students difficulties in longitude and latitude in particular, it is necessary to carry out a research to improve students' achievement and interest. This may be through the research on the effect of improvised instructional materials on the students' achievement and interest in longitude and latitude at senior secondary level (SS III). There has been relatively few research studies which evaluated the effect of instructional materials on achievement of students in mathematics but the extent of the quality and quantity of instructional materials that could enhance mathematics teaching and learning have not been generally agreed upon by researchers. In addition, there is lack of agreement about instructional strategies that could enhance the achievement and interest of students in longitude and latitude. On these bases, this study examined the effect of improvised instructional materials on the students' achievement and interest in longitude and latitude at senior secondary school level.

Statement of the Problem

The achievement of students in mathematics has been poor and discouraging over the years (Gimba, 2013). The poor achievement has been linked to the poor strategies employed by the teachers in teaching mathematics. Thus, these poor strategies have been attributed to the constant use of the traditional teaching methods (talk and chalk method) in teaching and learning mathematics (Akinsola, 2004).

Moreover, George (2008) linked the poor achievement of students to the low interest they exhibited in the study of mathematics and apathy towards it as a subject. In addition, gender and abstract nature of some topics have been identified as significant factors contributing to the poor achievement of students in mathematics. Afolabi and Adeleke (2010) identified inadequate instructional materials as one of the major causes of students' lack of interest and poor achievement in mathematics.

Although, researchers have recommended some innovative teaching strategies that will enhance students' achievement and interest in the subject for years, still WAEC Chief Examiners' Annual Report (2014) showed that students' achievement in mathematics has not improved. This necessitates further investigation on ways of improving the situation especially through the use of improvised instructional materials.

The problem of this study is therefore put forward thus: can the use of improvised instructional materials improve students' academic achievement and interest in Longitude and Latitude?

Purpose of the Study

The general purpose of the study is to determine the effect of improvised instructional materials on the achievement and interest of students in longitude and latitude at senior secondary school level (SS III).

Specifically, the study sought to determine the following:

- i. Effect of improvised instructional materials on the achievement of students in longitude and latitude.
- ii. Effect of improvised instructional materials on the interest of students in longitude and latitude.
- iii. Influence of gender on the achievement of students taught longitude and latitude with improvised instructional materials.
- iv. Influence of gender on the interest of students taught longitude and latitude with improvised instructional materials.

Research Questions

The following research questions were posed to guide the study:

1. What is the difference in the mean achievement scores of students taught longitude and latitude using improvised instructional materials (IIM), and traditional teaching method (TTM)?
2. What is the difference in the mean interest scores of students taught longitude and latitude using improvised instructional materials (IIM), and traditional teaching method (TTM)?
3. What is the influence of gender on the mean achievement scores of students taught longitude and latitude with improvised instructional materials (IIM), and traditional teaching method (TTM)?
4. What is the influence of gender on the mean interest scores of students taught longitude and latitude with improvised instructional materials (IIM), and traditional teaching method (TTM)?

Research Hypotheses

The following null hypotheses were formulated to guide the study and were tested at 0.05 level of significance:

- H0₁: There is no significant difference in the mean achievement scores of students taught longitude and latitude using improvised instructional materials (IIM) and traditional teaching method (TTM).
- H0₂: There is no significant difference in the mean interest scores of students taught longitude and latitude using improvised instructional materials (IIM), and traditional teaching method (TTM).
- H0₃: There is no significant difference in the mean achievement scores of the male and female students taught longitude and latitude using improvised instructional materials (IIM), and traditional teaching method (TTM).
- H0₄: There is no significant difference in the mean interest score of the male and female students taught longitude and latitude using Improvised Instructional

Materials (IIM), and traditional teaching method (TTM).

H0₅: There is no interaction effect of the improvised instructional materials (IIM), and gender on students mean achievement scores in longitude and latitude.

H0₆: There is no interaction effect of the improvised instructional materials (IIM) and gender on the mean interest scores in longitude and latitude.

Significance of the Study

The significance of the study has both theoretical and practical aspects. Theoretically, the findings are in agreement with the Piaget's cognitive learning theory which assumes that the learner is an intelligent and active processor of environmental experiences. Hence, the use of improvised instructional materials is a learning strategy that enables students to think critically, generate skills, predict, co-ordinate and control attempts to learn and solve problems to enhance their achievement and interest .

Practically, the following individuals and groups may benefit from the study: students, mathematics teachers, curriculum planners and researchers.

The study will help teachers to make more use of instructional materials that are more effective in their curriculum instructions.

The study may help the curriculum planners plan programmes that will encourage, develop and strengthen interest towards longitude and latitude by organizing seminars and workshop for teachers.

It is believed that the research findings would help Kogi State Ministry of Education and other educational stakeholders in secondary schools to plan and implement policies which ensure implementation of the uses of instructional packages for teaching mathematics so that mathematics can be taught and learn effectively.

Scope of the Study

The study was limited to senior secondary three (SS III) in Olamaboro Local Government Area of Kogi state. The senior secondary III was chosen because longitude and latitude is in SSIII syllabus. It is limited to senior secondary schools within the area. The content scope of this study was longitude and latitude which include: distances on small and great circles and longitude and latitude of various points on the earth surface. The choice of the concept is because students see it as an abstract and difficult mathematics concept.

II. METHODOLOGY

Design of the Study

The design of the study is quasi-experimental. This design is used in classroom experiment when experimental and control groups are naturally assembled as intact or pre-existing group

(Nworgu, 2006). Thus, the equivalence and equality of an experimental and control group was not assured. Specifically the design of this study was pretest – posttest non-equivalent control design. The experimental group received treatment using improvised instructional materials while the control group was taught using the traditional method.

Area of the Study

The study was carried out in Olamaboro Local Government Area of Kogi State.

Population of the Study

The population of this study consists of all the senior secondary III students in Olamaboro Local Government Area of Kogi State. The L.G.A. had thirty senior secondary schools with the population of 3000 senior secondary III (SS III) students with boys numbering 1200 and girls 1800.

Sample and Sampling Techniques

The sample of this study was made up of 175 students (82 male and 93 female) in the four intact classes randomly selected for the study. To sample the schools for study, the researcher purposively sampled all the co-education senior secondary schools in Olamaboro Local Government Area of Kogi State with at least two streams. From the sampled co-educational senior secondary schools, three co-educational secondary schools were randomly selected. The two schools were randomly assigned to treatment and control schools. In each school, two intact classes were randomly selected and used for the study. The reason for the use of co-educational senior secondary schools is to take care of the gender variation in the study.

Research Instruments

The researcher constructed two instruments for data collection. These are Longitude and Latitude Achievement Test (LLAT) and Longitude and Latitude Interest Scale (LLIS). The Longitude and Latitude Achievement Test is of 20 multiple choice test items each with four options. The Longitude and Latitude Interest Scale drafted consists of statement which express students feeling towards longitude and latitude. This is four points of the scale namely: strongly Agree -4, Agree -3, Disagree -2, strongly Disagree -1.

Validation and Reliability of the Instruments

The Longitude and Latitude Achievement test and Interest scale were subjected to content and face validation by the experts in Mathematics Education and Measurement and Evaluation in University of Nigeria Nsukka. The scores obtained from the trial testing were used to determine the internal consistency and reliability coefficient of the instruments used. Kuder – Richardson (K – R20) formula was considered necessary since the items were dichotomously scored. The reliability coefficient for Longitude and Latitude achievement test (LLAT) was 0.739 and the coefficient of Longitude and Latitude interest scale was 0.650. the

coefficient were high enough to consider the instruments reliable. Cronbach’s Alpha formula was used to establish the reliability of the LLIS.

Experimental Procedure

Before the treatment, the students in the treatment and control groups were pretested with the final draft of LLAT and LLIS instruments. The instruments were retrieved from the students immediately after the pretest. The students in the treatment groups were taught Longitude and Latitude using improvised instructional materials (frame of a sphere) while students in the control group were taught the same topic using the traditional teaching method. The exercise lasted for four weeks. The regular mathematics teachers in the selected schools were involved in the teaching. The researcher trained the teachers on distances on small and great circles on the earth surface using improvised instructional materials. The pretest scores were used as the covariance of the posttest scores. The data collected was used for further analysis.

Method of Data Analysis

Data collected for the study was analyzed as follows. Mean and standard deviation were used to answer all the research questions. Hypotheses formulated for this study were tested using analysis of covariance. The major Assumptions of ANCOVA include (i) The linearity between the dependent and covariate variables (ii) The homogeneity of regression or parallelism will be tested.

III. RESULTS

Research Question 1

What is the difference in the mean achievement scores of students taught Longitude and latitude using improvised instructional materials (IIM) and the traditional teaching method (TTM)?

Table 1: The means and standard deviations of pretest and posttest achievement scores

Group	N	Pre Test		Post – Test	
		Mean	SD	Mean	SD
Experimental	85	12.47	3.01	19.00	1.21
Control	90	11.73	2.40	13.17	3.08

From the data above, the experimental group, which represents those taught with improvised instructional materials, obtained a mean achievement score of 19.00 and a standard deviation of 1.21, while the control group representing those taught with traditional teaching method had a mean achievement score of 14.17 and standard deviation of 3.08.

Research Question 2

What is the difference in the mean interest scores of students taught longitude and latitude using improvised

instructional materials (IIM), and traditional teaching method (TTM)?

Table 2: The means and standard deviations pre-interest and post-interest scores

Group	N	Pre Interest		Post Interest	
		Mean	SD	Mean	SD
Experimental	85	54.07	3.88	67.20	4.40
Control	90	49.67	7.95	52.01	7.47

From the above, the experimental group 1 which represents those taught with improvised instructional materials obtained a mean interest score of 67.20 and standard deviation of 4.40 while the control group representing those taught with the traditional teaching method had a mean interest score of 52.01 and a standard deviation of 7.47

Research Question 3

What is the influence of gender on the mean achievement scores of students taught longitude and latitude with improvised instructional materials (IIM) ?

Table 4: The Mean and Standard Deviations of Pre- Interest and Post- Interest Scores of Male and Female Students.

Group	N	Pre Interest		Post Interest	
		Mean	SD	Mean	SD
Male	40	53.95	3.15	66.70	4.05
Female	45	54.18	4.46	67.64	4.68

From Table 4, the male students obtained a post interest score of 66.70 and a standard deviation of 4.05 while the female students obtained a post interest mean score of 67.64 and a standard deviation of 4.68.

Table 5: Test of between subjects effects dependent variable posttest.

Source	Type III sum of square	Df	Mean square	F	Sis
Corrected model	1997.573	2	998.789	374.741	.000
Intercept	590.687	1	590.687	221.623	.000
Pretest	510.073	1	510.023	191.377	.000
Groups	1236.330	1	1236.330	463.866	.000
Error	458.427	172	2.665		
Total	47256.000	175			
Corrected Total	2456.000	174			

Table 5 shows that the main effect was significant at 0.05 level of significance, thus, the null hypothesis of no significant difference in the mean achievement scores of students taught longitude and latitude with improvised instructional materials (IIM) and traditional teaching method (TTM) was significant and hence rejected. ($\alpha = 0.00 < 0.05$).

Table 3: The Means and Standard Deviation of Pre-Test and post Test achievement scores of male and female students

Group	N	Pre – Test		Post Test	
		Mean	SD	Mean	SD
Male	40	11.03	2.60	18.70	1.44
Female	45	13.76	2.79	19.27	0.89

From Table 3 above, the male students obtained a mean achievement score of 18.70 and a standard deviation of 1.44 while the female students obtained a mean post- test achievement score of 19.27 and a standard deviation of 0.89.

Research Question 4

What is the influence of gender on the mean interest scores of students taught longitude and latitude with improvised instructional materials (IIM) ?

Research Hypotheses

Hypothesis 1: There is no significant difference in the mean achievement scores of students taught longitude and latitude using improvised instructional materials (IIM) and traditional teaching method (TTM).

Hypothesis 2: There is no significant difference in the mean interest scores of students taught longitude and latitude with improvised instructional materials (IIM) and traditional teaching method (TTM).

Table 6: Test of between subjects effects. Dependent variable; post interest.

Source	Type III sum of square	Df	Mean square	F	Sig
Corrected model	10959.044	2	5479.522	165.042	.000
Intercept	4262.952	1	4262.952	4262.399	.000
Pre- Interest	874.055	1	874.055	874.055	.000
Group	7236.212	1	7236.212	7236.212	.000
Error	5710.533	172	33.201	33.201	
Total	633895.000	175			
Corrected Total	16669.577	174			

From table 6, the main effect is significant at 0.05 level of significance. Therefore, the null hypothesis of no significant difference in the mean interest scores of students taught longitude and latitude without improvised instructional materials was significant and hence H0 rejected ($\alpha = 0.000 < 0.05$).

Hypothesis 3: There is no significant difference in the mean achievement scores of of male and female students taught longitude and latitude with improvised instructional materials (IIM) and traditional teaching method (TTM) in longitude and latitude.

Table 7: Test of Between Subjects Effects. Dependent Variable Post Test

Source	Type III sum of square	Df	Mean square	F	Sig
Corrected model	76.388	2	38.194	68,664	.000
Intercept	823.223	1	823.223	1479.971	.000
Pre-test	69.588	1	69.588	125.104	.000
Sex	2.167	1	2.167	3.895	.052
Error	45.612	82	.556		
Total	30807.000	85			
Corrected total	122.000	84			

From Table 7 above, p-value =0.052 is greater than 0.05. This shows that there is no significant difference in the mean achievement scores of male and female students taught longitude and latitude using improvised instructional materials and those taught with traditional teaching method(TTM). Therefore, the null hypothesis is not rejected.

Hypothesis 4: There is no significant difference in the mean interest scores of male and female students taught longitude and latitude with improvised instructional materials (IIM) and the traditional teaching method (TTM) in longitude and latitude.

Table 8: Test of Between Subjects Effects. Dependent Variables: Post interest.

Source	Type III sum of square	Df	Mean square	F	Sig
Corrected model	43.734	2	21,867	1.135	.326
Intercept	1528.583	1	1528.583	79.338	.000
Pre-test	24.845	1	24.845	1.290	.259
Sex	17.618	1	17,618	0.914	.324
Error	1579.866	82	19.267		
Total	385470.000	85			
Corrected total	1623.600	84			

From Table 8 p-value is equal to .342 and is greater than 0.05. This shows that there is no significant difference in the mean interest scores of male and female students taught longitude and latitude using improvised instructional materials

and those taught with traditional teaching method (TTM) was significant and hence H0 rejected.

Hypothesis 5: There is no significant interaction effect between the use of improvised instructional materials and gender on students' achievement in longitude and latitude at senior secondary school level(SSIII).

Table 9: Test of between subjects Effects. Dependent variable: Post-Test

Source	Type III Sum of Square	DF	Mean Square	F	Sig.
Corrected model	2121.240	4	530.310	369.305	.000
Intercept	369.542	1	369.545	187.663	.000
Pretest	596.761	1	596.761	303.051	.000
Sex	115.769	1	115.769	58.790	.172
Error	334.760	170	1.969		
Total	47256.000	175			
Corrected total	2456.00	174			

From Table 9 above, $p = 0.272 > 0.05$. This shows that there is no significant interaction effect between the use of improvised instructional materials and gender on students' achievement in longitude and latitude at senior secondary school level (SSIII) therefore, the null hypothesis was not rejected.

Hypothesis 6: There is no significant interaction effect between the use of improvised instructional materials and gender on students' interest in longitude and latitude at senior secondary school level (SSIII).

Table 10: Test of Between Subjects Effect. Dependent variable: Post-Interest.

Source	Type III sum of square	Df	Mean square	F	Sig
Corrected model	13287.763	4	3321.941	166.990	.000
Intercept	286.700	1	286.700	14.412	.000
Pre-interest	2929.186	1	2929.186	147.247	.000
Group	4076.086	1	4076.086	204.900	.000
Sex	1291.674	1	1291.674	64.931	.000
Group & sex	1641.760	1	1641.760	82.529	.000
Error	3381.814	115	19.893		
Total	633859.000	120			
Corrected Total	1669.577	119			

From Table 10 above, $\alpha = 0.00 < 0.05$. This shows that there is a significant interaction effect between the use of improvised instructional materials and gender on students' interest in longitude and latitude at senior secondary level (SSIII). Therefore, the null hypothesis was rejected.

IV. DISCUSSION, FINDINGS, RECOMMENDATIONS AND SUMMARY

The main aim of this study was to investigate the effect of improvised instructional materials on students' achievement and interest in longitude and latitude at senior secondary school level (SS III). Six hypotheses were formulated based on the research questions. The data collected were analyzed using mean and standard deviation. ANCOVA was used to test the hypotheses at 0.05 level of significance.

From table 1, the result revealed that the use of improvised instructional materials (Frame of a Sphere) in

teaching produced a higher mean achievement score of 19.00 in longitude and latitude achievement test than the traditional teaching method. Also, Therefore, the result from this study agreed with Usman and Obioda(2005) who maintained that the teachers have to use activities involving instructional materials to allow the students' participation for higher achievement.

The results in table 2 revealed that the students taught with improvised instructional materials in longitude and latitude had a higher mean interest score 67.20 than those taught without improvised instructional materials. Those exposed to improvised materials also performed better than those taught using conventional method.

Table 4 revealed that there was no significant difference between achievement scores of male and female students taught longitude and latitude using improvised instructional materials and computer animation. The finding is

in agreement with the findings of Alio(2000) who affirmed that students interest towards problem is a significant factor.

Findings also revealed that there is a significant difference in the mean achievement scores of students taught using improvised instructional materials and the traditional teaching method.

V. CONCLUSION AND RECOMMENDATIONS

From the findings and discussion of this study, the following conclusions were made: Use of improvised instructional materials is significantly better than the use of the traditional teaching method in enhancing students achievement and interest in longitude and latitude.

Based on these, the following recommendations were made:

- i. Mathematics teachers should embark on the use of improvised instructional materials for teaching and learning in senior secondary schools.
- ii. The non-governmental organizations, communities, individuals, groups, schools, state and federal government should ensure that workshops and seminars are organized often on how to design, produce and utilize instructional materials.
- iii. Professionals, associations and research centres such as Science Teachers Association of Nigeria (STAN), Mathematics Association of Nigeria (MAN), National Mathematical Centre (NMC) and the Nigeria Education Research and Development Council (NERDC) should incorporate the use of improvised instructional materials and Computer Assisted Instructional (CAI) packages in mathematics and secondary curriculum at senior secondary school level.

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