Effects of Teachers'Use of Improvised Instructional Materials on Students' Achievement and Interest in Mensuration

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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 Mensuration. The influence of gender on the achievement and interest of the students taught with improvised instructional materials was also considered. Four research questions and four 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 Obafemi-Owode Local Government Area of Ogun 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 – Mensuration Achievement Test (MAT) and Mensuration Interest Scale (MIS) 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, Instructional materials, Interest, Achievement, Mensuration

I. INTRODUCTION

Mathematics is one of the subjects that were highly addressed in the National Policy of Education by the Federal Ministry of Education. Mathematics is a subject that is taken seriously in the school system because of its importance to the national development, irrespective of country or level of education it has been described as a model of thinking, which encourages learners to observe, reflect and reason logically about a problem and in communicating ideas, making it the central intellectual discipline and a vital tool in science, commerce and technology (Imoko& Agwagah,2006; Iji,2008).Mathematics affords man the opportunity to know and access things and objects within his immediate and remote environment(Kolawole & Oluwatayo,2005). Salman (2005) defines mathematics as a precursor of scientific discoveries and innovations.

In spite of the importance and popularity of mathematics to all aspect of human endeavors, many research findings show that there is increasingly poor achievement in the subject among secondary school students (Abakpa &Iji, 2011;I wendi, 2012; Anaduka& Okafor,2013; Olosunde& Akinpelu,2013). Achievement can be defined as a measure of learner's level of knowledge, skills or performance (Ugwu, 2014). Brown (2005) described achievement as the level of goal accomplishment. Akinbobola(2006)described achievement of students as learning outcomes which include the knowledge, the skill and experiences acquired in both classroom and laboratory practices. Uwadiae (2010)reported thatless than 42% of registered candidates obtained credit pass in Mathematics. 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(Mensuration) (West African Examination Council Chief Examiners' Report, 2019). Reports from WAEC on students' poor achievement in mathematics continued in the Chief Examiners' Reports from 2010-2019. In 2010,2011,2012,2013, 2014,2015,2016,2017,2018 and 2019, 38.3%, 31.28%,34.52%,38.9%,40.5%,35.65%, 39.25,45.8%, 52.15% 36.57% of the students had credits in mathematics respectively. Several factors have been attributed to the poor

performance in secondary school mathematics, among which are: poor methods of teaching (Harbour- Peters, 2001), poor interest in mathematics (Badmus, 2002 &Obodo, 2004), gender difference (Agwagah, 2000) and lack of appropriate instructional materials for teaching mathematics at all levels of education in Nigeria (Gambari, 2010).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 (2002) 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&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&Agwagah, 2006). Ezike and Obodo (2001) defined interest as condition of wanting to know or learn about some objects. Interest simply means the likes and dislike or one's reference and aversion (George, 2008). Onah(2015) stated that achievement means gaining or reaching successfully while interest means curiosity or attention. 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. Instructional materials can be improvised(Strengthening Mathematics and Science Education Project, 2010). Adebimpe (1997),Aguisiobo (1998) and Onasanya et al (2008), noted that improvisation demands adventure, creativity, curiosity and perseverance on the part of teachers.

GambariandGhana (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 (2009) 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). 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).

Resourceful and skillful teachers should improvise necessary instructional materials to promote academic standard in Nigerian schools (Abdu-Raheem & Oluwagbohunmi,2015).

Shih, Kuo and Liu (2012) developed and evaluated instructional model and learning system and found that the model enhanced mathematical achievement. Mensuration is a branch of mathematics which deals generally with geometric shapes and measurement. Ask.com (2016) defined mensuration as a branch of mathematics which deals with the measurement of areas and volumes of different geometrical figures. The related parameters which are taught in mensuration include but not limited to types and properties of geometric shapes (plane or solid), the measurement of the dimensions that form the shapes, the diagrams and nets of the shapes, the area and volumes of the shapes, the properties of the shapes, the relationships between the properties of the shapes, the development and use of formula to solve mensuration problems. Generally, the relevance of mensurationand 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 2010 – 2019 as area of students' difficulty. This study will thus focus on mensuration. Having seen the importance of mathematics as the determinant of quality of technological advancement in addition to students' difficulties in mensuration 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 mensuration at senior secondary level (SS I). There have 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 mensuration. On these bases, this study examined the effect of improvised instructional materials on the students' achievement and interest in mensuration at senior secondary school level 1

II. 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 (2018) 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 Mensuration?

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 Mensuration at senior secondary school level (SS I).

Specifically, the study sought to determine the following:

I. Effect of improvised instructional materials on the achievement of students in mensuration
II. Effect of improvised instructional materials on the interest of students in mensuration
III. Influence of gender on the achievement of students taught mensuration with improvised instructional materials.
IV. Influence of gender on the interest of students taught mensuration with improvised instructional materials

Research Questions
The following research questions were posed to guide the study:
- What is the difference in the mean achievement scores of students taught mensuration using improvised instructional materials (IIM), and traditional teaching method (TTM)?
- What is the difference in the mean interest scores of students taught mensurationusing improvised instructional materials (IIM), and traditional teaching method (TTM)?
- What is the influence of gender on the mean achievement scores of students taughtmensuration with improvised instructional materials (IIM), and traditional teaching method (TTM)?
- What is the influence of gender on the mean interest scores of students taught mensuration 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 mensuration using improvised instructional materials (IIM) and traditional teaching method (TTM).

H02: There is no significant difference in the mean interest scores of students taught mensuration using improvised instructional materials (IIM), and traditional teaching method (TTM).

Ho3: There is no significant difference in the mean achievement scores of the male and female students taught mensuration 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 mensuration using Improvised InstructionMaterials (IIM), and traditional teaching method (TTM).

Significance of the Study

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 mensuration by organizing seminars and workshop for teachers

It is believed that the research findings would help Ogun 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 it can be taught and learn effectively.

Scope of the Study

The study was limited to Senior Secondary I (SS I) in Obafemi-OwodeLocal Government Area of Ogun state. The Senior Secondary I(SSI) was chosen because mensuration is in SSI syllabus. It is limited to Senior Secondary Schools within the area. The content scope of this study was mensuration which include: Area of 2D shapes, Area and Volume of 3D shapes. The choice of the concept is because students see it as an abstract and difficult mathematics concept.

III. 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 Obafemi-Owode Local Government Area of Ogun State.

Population of the Study

The population of this study consists of all the Senior Secondary I students in Obafemi-Owode Local Government Area of Ogun State.

Sample and Sampling Techniques

The sample of this study was made up of 185students (92 male and 93 female) in the four intact classesrandomly selected for the study. To sample the schools forstudy, the researcher purposively sampled all the co-educationsenior secondary schools in Obafemi-OwodeLocal GovernmentArea of Ogunstate with at least two streams. From thesampled co-educational senior secondaryschools, three co-educationalsecondary schools were randomly selected. Thetwo schools were randomly assigned to treatment and controlschools. In each school, two intact classes were randomlyselected and used for the study. The reason for the use of co-educationalsenior secondary schools is to take care of thegender variation in the study.

Research Instruments

The researcher constructed two instruments for datacollection. These are Mensuration AchievementTest (MAT) and Mensuration Interest Scale(MIS). The Mensuration Achievement Test is of30 multiple choice test items each with four options. TheMensuration Interest Scale drafted consists ofstatement which express students feeling towards mensuration. This is four points of the scale namely: StronglyAgree - 4, Agree -3, Disagree -2, Strongly Disagree -1.

Validation and Reliability of the Instruments

The Mensuration Achievement test andInterest scale were subjected to content and face validation bythe experts in Mathematics Education and Measurement andEvaluation in Olabisi Onabanjo University (OOU), Ago-Iwoye. The scoresobtained from the trial testing were used to determine the

internal consistency and reliability coefficient of theinstruments used. Kudder – Richardson (K – R20) formulawas considered necessary since the items were dichotomouslyscored. The reliability coefficient for Mensuration Achievement test (MAT) was 0.763 and the coefficient ofMensurationandInterest scale (MIS) was 0.654, thecoefficient was high enough to consider the

instrumentsreliable. Cronbach's Alpha formula was used to establish thereliability of the MIS

Experimental Procedure.

Before the treatment, the students in the treatmentand control groups were pretested with the final draft of MAT and MIS instruments. The instruments were retrievedfrom the students immediately after the pre-test. The studentsin the treatment groups were taught Mensurationusing improvised instructional materials while students in the control group were taught the same topicusing thetraditional teaching method. The exercise lasted forfour weeks. The regular mathematics teachers in the selectedschools were involved in the teaching. The researcher trainedthe teachers on Area of 2D shapes, Area and Volume of 3D shapesusing improvised instructional materials. Thepre-test

scores were used as the covariance of the post-testscores. The data collected was used for further analysis

IV. METHOD OF DATA ANALYSIS

Data collected for the study was analyzed as follows.

Mean and standard deviation were used to answer all theresearch questions. Hypotheses formulated for this study weretested using analysis of covariance

Results

Research Question 1

What is the difference in the mean achievement scores ofstudents taught Mensuration using improvisedinstructional materials (IIM) and the traditional teachingmethod (TTM)?

Table 1: The means and standard deviations of pre -test and post-test achievement scores

Group	N	PRETEST		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, whichrepresents those taught with improvised instructionalmaterials, obtained a mean achievement score of 19.00 and astandard deviation of 1.21, while the control grouprepresenting those taught with traditional teaching method hada mean achievement score of 13.17 and standard deviation of3.08

Research Question 2

What is the difference in the mean interest scores ofstudents taught mensuration using improvisedinstructional 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 representsthose taught with improvised instructional materials obtaineda mean interest score of 67.20 and standard deviation of 4.40 while the control group representing those taught with thetraditional teaching method had a mean

interest score of 52.01and a standard deviation of 7.47

Research Question 3

What is the influence of gender on the meanachievement scores of students taught Mensuration with improvised instructional materials (IIM)?

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 post-testachievement score of 18.70 and a standard deviation of 1.44while the female students obtained a mean post- testachievement score of 19.27 and a standard deviation of 0.89.

Research Question 4
What is the influence of gender on the mean interestscores of students taught Mensuration withimprovised 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-TEST		POST- TEST	
		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 scoreof 66.70 and a standard deviation of 4.05 while the femalestudents obtained a post interest mean score of 67.64 and astandard deviation of 4.68.

Research Hypotheses
Hypothesis 1: There is no significant difference in the meanachievement scores of students taught Mensuration using improvised instructional materials (IIM) and traditionalteaching method (TTM).

Table 5: Test of between subject effects dependent variable post-test

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
Pre-test	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 0.05level of significance, thus, the null hypothesis of nosignificant difference in the mean achievement scores ofstudents taught mensuration with improvisedinstructional materials (IIM) and traditional teaching method(TTM) was significant and hence rejected. ($\alpha = 0.00 < 0.05$).

Hypothesis 2: There is no significant difference in the meaninterest scores of students taught Mensuration withimprovised instructional materials (IIM) and traditionalteaching 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-test	874.055	1	874.055	874.055	.000
Groups	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 ofsignificance. Therefore, the null hypothesis of no significantdifference in the mean interest scores of students taught Mensuration without improvised instructionalmaterials was significant and hence H_0 rejected ($\alpha = 0.000 < 0.05$)

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

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. Thisshows that there is no significant difference in the meanachievement scores of male and female students taught Mensuration using improvised instructional materialsand those taught with traditional

teachingmethod (TTM). Therefore, the null hypothesis is not rejected.

Hypothesis 4: There is no significant difference in the meaninterest scores of male and female students taught Mensuration with improvised instructional materials (IIM) andthe traditional teaching method (TTM)

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	19.26		
Total	385470.000	85			
Corrected Total	1623.600	84			

From Table 8 p-value is equal to .342 and is greater than0.05. This shows that there is no significant difference in themean interest scores of male and female students taught mensuration using

improvised instructional materialsand those taught with traditional teaching method (TTM), hence H_0 was rejected.

Conclusion and recommendations

The results of the above research finding naturally lend themselves to the following conclusions and recommendations

The use of improvisation of instructional materials in the teaching of Mathematics has efficacy to improve academic performance of mathematics students. The effective teaching and learning of mathematics in our schools requires the use of instructional materials rather than the old traditional methods such as lecturing and note-taking. Again, improvisation of instructional materials enables the teacher bridge gender gap in mathematics academic performance, since males and females benefit equally when improvised material are used in the teaching of mathematics.

It is therefore recommended that:

- In the absence of standard instructional materials, teachers should be encouraged to use improvised materials for teaching Mathematics.
- Workshops should be organised to train Mathematics teacher to be proficient in improvisation.
- Attitude of teachers and students towards the use of improvised instructional materials should be boosted through counselling and provision of tools and resources for improvisation.
- The government should improve funding for the study of Mathematics
- Lastly, the government should restore the payment of hazard allowance to Mathematics teachers, since improvisation could sometimes be hazardous.

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