

THE EFFECT OF HANDS-ON ACTIVITIES ON PRIMARY SCHOOL PUPILS' ACHIEVEMENT AND RETENTION IN FRACTION

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Abstract

The study examined the effect of hands-on activities on mathematics pupils' achievement and retention in fraction in Afijio Local Government Area of Oyo State, Nigeria. The study adopted quasi-experimental research design. The instrument used for data collection was Fraction Achievement Test (FAT) with the reliability coefficient of 0.89 using Pearson R. coefficient. The target population of this study was all the basic five pupils in Oyo State. A sample of 290 basic five pupils comprising 158 males and 132 females selected from eight schools within the Local Government Area under study using multi-stage sampling techniques. Four null hypotheses guided the study. The research hypotheses were tested at 0.05 level of significance using Analysis of Covariance (ANCOVA). The study revealed that there is a significant difference between hands-on activities and conventional methods of teaching in favour of hands-on activities, there is significant difference in the mean retention scores between the pupils taught fraction using hands-on activities and those taught with conventional method in favour of hands-on activities, there is no significant difference between the mean achievement of male and female pupils taught fraction using hands-on activities and there is no significant difference between the mean retention scores of male and female pupils taught fraction using hands-on activities. Based on the findings, it was recommended among others that pre-service mathematics teachers should be trained on the use of hands-on activities and serving teachers should use it.

Keywords: *Hands-On, Activities, Achievement, Retention and Fraction.*

Introduction

Mathematics education is the right education by which social and economic development can be achieved through the inculcation of the right human values in the children (Mayowa, 2011). Mathematics education is concerned with the practice of teaching and learning in and outside the classrooms. One of the objectives of secondary school mathematics is to enable the individual to think creatively and constructively. Mathematics since its invention has influenced positively the culture and thought of various nations and has in no small measure helped in revolutionalising the world (Emeniru, 2019). Eya (2017) opined that mathematics is an essential part of human culture, which the educational system is designed to transmit. Mathematics is the best way to teach youngsters how to think. The volume and quality of mathematics offered in the school system determine the prosperity of any country. Ezeom and Afe (2014) defined mathematics as a culture that allows man to know and access things and objects within his immediate and remote environment. Mathematics through careful and logical thinking can be

used to solve human problems in all spheres of life. Mathematics through reasoning can give insight into the power of the human mind (Onifade, 2017).

Consequently, the teaching and learning of mathematics have become a great concern to educationists (Garba, 2013). A good number of research efforts have been made to diagnose the problems associated with the teaching and learning of Mathematics in order to proffer solution that could lead to better achievement (Olawaju, 2014). Among the factors that hinder pupils' achievement in mathematics include pupils' background problems, pupils' lack of interest and/or negative attitude towards mathematics, teacher related factors such as poor teacher preparation, inadequate qualified mathematics teachers, inadequate instructional materials and poor teaching methods (Usman, 2011; Olorunyomi, 2013; Haruna, 2014). Jegede (2014) reports that the percentage passes in Senior Secondary Certificate Examination (SSCE) are not good enough especially for candidates that want to study science-based courses or for candidates that may include mathematics as one of the relevant five subjects passed at credit level in order to be admitted into any higher institution in Nigeria.

A fraction (from Latin fractus, "broken") represents a part of a whole or, more generally, any number of equal parts (Ali, 2012). In everyday English, a fraction describes how many parts of a certain size there are, for example, one-half, eight-fifths, three-quarters. A fraction is a part of a whole expressed as a figure placed on top of another figure. The one on top is called the numerator while the one below is called the denominator. A number in the form $\frac{a}{b}$ is said to be a fraction if $b \neq 0$ (Martine, 2011; Mishira & Yadav, 2013). Fractions are among the most complex mathematical concepts that children encounter in their years in primary education. One of the main factors contributing to this complexity is that fractions comprise of multifaceted notion encompassing five inter related sub constructs (part-whole, ratio, operator, quotient and measure). Teaching and learning fractions has traditionally been problematic. In fact, it is well documented that fractions are among the most complex mathematical concepts that children encounter in their years in primary education and hard to be understood by pupils (Cemalettin & Tuğrul, 2012; Mohyuddin & Khalil, 2016). Similarly, studies have shown that teachers and pre-service teachers have some difficulties on division in fractions similar to those faced by pupils (Toluk-Uçar, 2009). It was observed that fraction knowledge is sometimes being misused in applying procedural knowledge when solving problems. Learners confuse themselves by muddling fraction arithmetic procedures with simple arithmetic knowledge. When calculating $\frac{2}{5} + \frac{1}{3}$, many learners write down the answer as $\frac{3}{8}$ instead of $\frac{11}{15}$.

Abudullai (2013) describes hands-on activities as a method of teaching whereby pupils are engaged actively in class activities with the use of their hands and intellect under the guidance of the teacher. The furthermore it allows learner to demonstrate competency in materials and practical activities either by using his/her hands or other mechanical competencies. Hands-on activities by implication show that pupils have objects directly available for investigation. Other terms for hands-on activities include material centered activities, manipulative activities, and practical activities (Reeds & Shah, 2007; Tile, 2013). Teaching and learning processes which involves hands-on activities is believed to help pupils in understanding theories and principles which are difficult or abstract.

A meta-analysis of the effectiveness of hands-on activities by Abah (2012) suggested that pupils may acquire more knowledge in short term when taught conventionally but are likely to

retain knowledge longer when taught with hands-on activities. Gallagher (2010) concluded in a study that hands-on activities is more effective than traditional instruction that it's result in better long-term retention than traditional methods of teaching. Adepoju (2012) describes retention as the level at which an individual is capable to re-call an acquired knowledge at any given time. The author adds that retention is measured in collaboration with achievement. This means that achievement is a function of retention.

Hornby (2002) in Tyopav (2013) describes retention as the ability to remember experiences and things learnt. Similarly, Kundu and Tutoo (2002) in Olom (2010) posit that retention is the preservation of mind. These imply that the amount of knowledge learnt and kept, skill maintained or problem-solving behaviours manifested consistently reflects what is retained. By implication, retaining knowledge of fraction is the ability of a learner to keep and remember as well as recall or reproduce the acquired knowledge or some parts of the knowledge after some period of time must have elapsed. Therefore, to improve pupils' achievement level in fraction, implies to improve the level at which they retain the concepts of fraction learnt. Bichi (2007) reports that anything that aids learning should improve retention while things that lead to confusion or interference among learned material decrease the speed and efficiency of learning and accelerates forgetting. Hence the study sees the need to find out if hands-on activities could improve retention of male and female pupils in fraction.

Gender inequality in science and education in general has remained a perennial problem of global scope (Tile, 2013). The differences between boys and girls in relation to mathematics achievement have received a lot of attention. Some studies indicate that boys achieve better (Gipps, 2004; Kingdon, 2009; Calsambis, 2007; Ventura, 2008; Mohapatra & Mishra, 2008) or girls outperform boys (Chambers, 2008; Soyibo, 2009) have been demonstrated. Studies on gender differences in mathematics achievement continue to yield inconsistent results and it has usually been attributed to unequal exposure of males and females to learning instructions relevant to mathematics learning. Therefore, it is of interest to find out if sex of pupils could predict their achievement and retention in fraction using hands-on activities. Other effect of hands-on activities may still exist which can either positively or negatively have effect on mathematics pupils' achievement and retention (Eze, 2010; Al- Mustapha (2014). However, research particularly in the Nigerian context is being silent about them. It is on this note that this study is set out to examine the effect of hands-on activities on primary school mathematics pupils' achievement and retention in fraction in Oyo State using Afijio Local Government Area as a study area.

Statement of the Problem

Fractions play an important role in the ever-advancing technological society. Many occupations today rely heavily on the ability to compute accurately, proficiently, and insightfully with fractions. However, many pupils have difficulty with fractions and computations involving fractions. Due to the nature of the topic (fraction) pupils commit different errors while trying to solve problems involving fraction. These errors include; inability to interpret a word problem, the inability to translate and manipulate signs, inability to read and understand fractions problems.

Poor method of teaching invariably translates to pupils' poor achievement and inability to retain and to put into practice what is learnt in reality has become a hydra-headed problem. In most cases, what is taught in classroom cannot be transferred to real life situation by pupils. The nation's quest for science and technological advancement will become a mirage, if effective

modality is not put in place to incorporate innovative methods that promote active learning and considering the importance of mathematics in all round development, there is needs to make sure that mathematics is properly taught most especially the difficult concepts such as fraction using innovative methods such as hands-on activities.

Purpose of the Study

The purpose of this study was to examine the effect of hands-on activities on pupils' achievement and retention in fraction in Oyo State. Specifically, the study:

1. Determined the effect of hands-on activities on pupils' achievement in fraction.
2. Ascertained the effect of hands-on activities on pupils' retention in fraction.
3. Find out if there is any difference in effect of hands-on activities between male and female pupils' achievement in fraction.
4. Determined the difference in effect of hands-on activities between male and female pupils retention in fraction.

Research Hypotheses

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

H₀₁: There is no significant difference in the mean achievement scores between pupils taught fraction using hands-on activities and those taught using conventional method.

H₀₂: There is no significant difference in the mean retention scores between pupils taught fraction using hands-on activities and those taught using conventional method.

H₀₃: There is no significant difference in the mean achievement scores between male and female pupils taught fraction using hands-on activities.

H₀₄: There is no significant difference in the mean retention scores between male and female pupils taught fraction using hands-on activities.

Significance of the Study

The findings of this study will create confidence in the teachers that the use of hands-on activities is capable of improving the achievement and retention level of pupils. It will be a wakeup call for mathematics teachers to realize the importance of hands-on activities. Mathematics teachers would be acquainted with the way and manner activities are carried out among and correcting them where needs be thereby boosting pupils' zeal for mathematics and self-reliance. The findings will also enable the mathematics teachers see the need for male and female participation in class activities. The findings will also act as pointer to the direction of sex so as to pay more attention to such sex if differences exist.

Specifically, school authorities, teachers, pupils, pupils, educational administrators, prospective researchers and curriculum developers will stand to benefit from the findings of this study. The findings of this study will be a frame work for further studies in related studies in mathematics or other fields.

Methodology

The study adopted a quasi-experimental non-randomized pre-test, post-test control group design. The main thrust of the experimental design is to establish cause-and-effect relationship. Intact classes were randomly assigned to experimental and control groups.

The population of the study comprises of all the basic five pupils in Afijio Local Government Area of Oyo State. The sample of this study was made up of 290 pupils comprising 158 boys

and 132 girls selected from eight public primary schools within the Local Government Area under study out of 17 public primary schools in the Local Government Area.

There are 145 pupils in the experimental group and 145 pupils in the control group. They were assigned randomly to experimental and control groups. The experimental group comprised four intact classes while the control group also comprised four intact classes.

Research instrument used for this study was a self structured instrument tagged Fraction Achievement Test (FAT). FAT contains two sections. Section A contains bio-data information of the respondents, while section B contains twenty (20) objective items questions to which respondents are expected to provide the correct answer by completing the gaps. The content of FAT was drawn based on the mathematics basic five syllabus. The use of FAT is to assess pupils' achievement and retention on what they have been taught.

The instrument was given both face and content validity by two senior lecturers in the field of measurement and evaluation at the Department of Educational Psychology, Federal College of Education (Special), Oyo, Oyo State. The instrument was trial-tested to establish the reliability coefficient of the instrument by administering FAT to a randomly selected 20 basic five pupils from a primary school which is not part of the schools selected for this study. Test retest procedure was used in administering the instrument on the pupils. Two intact classes basic 5A (experimental) and basic 5B (Control) randomly were selected. This was to ensure that there was no variance in the school organization and setting. The experimental group was taught using hands-on activities while the control group was taught using conventional method. FAT was administered in form of pre-test to the two groups before treatment to ascertain their entry behaviour. After 4 weeks of 16 periods of teaching, the pre test was reshuffled and administered as post test to ascertain the stability of the instrument. The post-test was scored and compared with the pre-test scores to see if there could be any correlation relationship between the two scores of the test. Pearson R. was used to obtain the reliability, which yielded a reliability coefficient of 0.89.

The study took place during the normal school lesson periods after permission is sought from the school heads. Intact classes were assigned to experimental and control groups after which the instrument was administered as pre-test by the researcher with the assistance schools mathematics teachers. This lasted for one week before actual teaching commenced. The control group was taught the same fraction topics using the conventional method of teaching. In all the sampled schools, the actual teaching lasted for four weeks of sixty-four periods to cover all the units of fraction concepts. At the end of these periods, the pre-test was reshuffled and administered as post-test which lasted for one week and the post test was marked by the research assistants using the marking scheme developed by the researchers. The pre-test score constituted the covariant of the post-test scores. The researchers allowed a gap of another period of four weeks in order to find out if the knowledge gained was retained. The post-test was reshuffled and administered as retention test to measure the subjects on retention. The retention test was score by the researcher with the marking scheme produced the null hypotheses were tested at 0.05 level of significance using Analysis of Covariance (ANCOVA).

Result

The data collected using the instrument developed for the study is analyzed and interpreted based on the research hypotheses formulated.

Hypothesis One: There is no significant difference in the mean achievement scores between pupils taught fraction using hands-on activities and those taught using conventional method.

Table 1: ANCOVA Tests for Mean Achievement Scores of pupils taught fraction using Hands-on Activities and those taught using pupils Method
Dependent Variable: Achievement-Test

Sources	Type III Sum of Square	Df	Mean Square	F	Sig.
Corrected model	1700.332 ^a	2	850.166	135.821	.000
Intercept	1792.021	1	1792.021	572.581	.000
Pre-test	297.305	1	297.305	56.184	.000
Method	1634.888	1	1634.888	554.373	.000
Error	901.361	287	3.1406		
Total	109366.000	290			
Corrected Total	2601.693	289			

ANCOVA Tests result in Table 1 reveals that there is a significant difference between hands-on activities and conventional methods of teaching in favour of hands-on activities $F(1,287) = 554.373$, $P(0.0001 < 0.05)$. The null hypothesis is therefore rejected. This implies that hands-on activities method is more effective than conventional method in achievement of pupils in fraction.

Hypothesis Two: There is no significant difference in the mean retention scores between pupils taught fraction using hands-on activities and those taught using conventional method.

Table 2: ANCOVA Tests for Mean Retention Scores of pupils taught fraction using Hands-on Activities and those taught conventional Method
Dependent Variable: Retention-Test

Sources	Type III Sum of Square	Df	Mean Square	F	Sig.
Corrected model	3668.557 ^a	2	1834.279	304.742	.000
Intercept	1694.134	1	1694.134	562.912	.000
Pre-test	202.482	1	202.482	51.825	.000
Method	3536.532	1	3536.532	115.424	.000
Error	866.754	287	3.0200		
Total	102150.000	290			
Corrected Total	4535.311	289			

ANCOVA Tests result in Table 2 reveals that there is significant difference in the mean retention scores between the pupils taught fraction using hands-on activities and those taught with conventional method in favour of hands-on activities $F(1,287) = 115.424$, $P(0.0001 < 0.05)$. The null hypothesis is therefore rejected. This means that hands on activities enhanced pupils' retention in fraction.

Hypothesis Three: There is no significant difference in the mean achievement scores between male and female pupils taught fraction using hands-on activities.

Table 3: ANCOVA Tests for Mean Achievement Scores of Male and Female pupils taught fraction using Hands-on Activities.

Dependent Variable: Achievement-Test

Sources	Type III Sum of Square	Df	Mean Square	F	Sig.
Corrected model	1014.434 ^a	2	507.217	102.108	.000
Intercept	1336.755	1	1336.755	390.385	.000
Pre-test	211.098	1	211.098	67.876	.000
Gender	14.244	1	14.244	4.140	.064
Error	558.144	142	3.9306		
Total	75044.000	145			
Corrected Total	572.578	144			

ANCOVA Tests result in Table 3 reveals that there is no significant difference between the mean achievement of male and female pupils taught fraction using hands-on activities $F(1,142) = 4.140$, $P(0.064 > 0.050)$. The null hypothesis is therefore not rejected. This means that hands-on activities enhanced both male and female pupils' achievement in fraction.

Hypothesis Four: There is no significant difference in the mean retention scores between male and female pupils taught fraction using hands-on activities.

Table 4: ANCOVA Tests for Mean Retention Scores of Male and Female pupils taught fraction using Hands-on Activities.

Dependent Variable: Retention-Test

Sources	Type III sum of square	df	Mean square	F	Sig.
Corrected model	1011.125 ^a	2	505.5625	102.007	.000
Intercept	1497.950	1	1497.950	540.606	.000
Pre-test	198.879	1	198.879	66.190	.000
Gender	8.636	1	8.636	3.119	.079
Error	451.652	142	3.1806		
Total	75997.000	145			
Corrected Total	462.777	144			

ANCOVA Tests result in Table 4 reveals that there is no significant difference between the mean retention scores of male and female pupils taught fraction using hands-on activities $F(1,142) = 3.119$, $P(0.079 > 0.050)$. The null hypothesis is therefore not rejected. This means that hands-on activities enhanced both male and female pupils' retention in fraction.

Discussion of Findings

The findings of this study have revealed that pupils taught fraction using hands-on activities achieved higher than their counterparts taught using conventional method. This finding agrees with Martine (2011) and Mishira and Yadav (2013) who found that pupils achieved higher when exposed to hands-on activities than their counterparts that were exposed to traditional method in science subjects. The likely explanation for this outcome may be connected to the fact that the

hands-on activities helped the learner to possess a meaningful in-depth knowledge of the content area when compared to the conventional method.

It was also found that pupils exposed to hands-on activities have higher retention capacity than their counterpart that was exposed to conventional method. This finding agrees with Ali (2012) who found that pupils have higher retention capacity when they are actively engaged in solving problems through hands-on activities than when they become passive learners as obtained in the use of traditional method. The likely explanation for this outcome may also be connected to the fact that the use of hands-on activities in science teaching orient pupils towards reflecting on, interpreting and searching for solutions to the problems themselves when compared to the conventional method.

Another major finding in this study was that male pupils achieved slightly higher than their female counterparts using hands-on activities but ANCOVA test shows that the difference was no significant. This finding agrees with the findings of Eze (2010) and Al- Mustapha (2014) who found that there was no significant statistical difference on the achievement of male and female pupils in Mathematics. Based on this finding, achievement in mathematics is therefore not dependent on gender. This means that the age long disparity in science between male and female pupils can be laid to rest with the use of hands-on activities. However, the finding contradicts the finding of Abe (2011) who found gender disparity in pupils' achievement in favour of female in basic science.

The finding also revealed the efficacy of the use of hands-on activities in enhancing pupils' retention capacity in fraction irrespective of gender. The finding agrees with Olarewaju (2014) who found no gender disparity in junior secondary pupils' retention in Basic Science. This implies that in order to encourage gender equivalence in retention of mathematical concept, hands-on activities should be embraced by mathematics teachers. However, the finding contradicts the finding of Garba (2013) who found that female pupils' have higher retention capacity than their male counterparts in Integrated Science and also contradicts the finding of Mayowa (2011) who found that male pupils' have higher retention capacity than their female counterparts in Biology. However, the likely reason for the agreement of these findings could be that hands-on activities method enhances greater retention capacity of pupils through lasting comprehension of things they do in comparison with the ones they only see or hear irrespective of gender.

Summary

The purpose of this study was to find out if hands-on activities have effect on pupils' achievement and retention in fraction among basic five pupils in Afijio Local Government of Oyo State, Nigeria. Specifically, the study examined the effect of hands-on activities on pupil's achievement and retention in fraction in two study groups namely; the control and experimental groups. It also examined the effect of hands-on activities on pupil's achievement and retention in fraction between male and female students. Four null hypotheses were formulated and tested for the study.

The study adopted a quasi-experimental design of pre-test, post-test, nonrandomized control groups. Intact classes in the sampled schools were used since complete randomization of subjects was not possible. 290 basic five pupils from eight schools in the study area were used. A self structured research instrument tagged Fraction Achievement Test (FAT) was used for the study. Analysis of Covariance (ANCOVA) was used to test the null hypotheses. Based on the data collected and analyzed, the following findings were made:

1. There is a significant difference between hands-on activities and conventional methods of teaching in favour of hands-on activities.
2. There is significant difference in the mean retention scores between the pupils taught fraction using hands-on activities and those taught with conventional method in favour of hands-on activities.
3. There is no significant difference between the mean achievement of male and female pupils taught fraction using hands-on activities.
4. There is no significant difference between the mean retention scores of male and female pupils taught fraction using hands-on activities.

Conclusion

The use of hands-on activities enhanced pupils' achievement in fraction. It also enhanced pupils' retention than the use of conventional method. No gender disparity exists in the achievement and retention capacity of male and female mathematics pupils taught fraction using hands-on activities. This implies that hands-on activities method is very rewarding to pupils' in-terms of achievement and retention capacity regardless of gender.

Recommendations

Based on the findings and conclusion of this study, it was recommended that since hands-on activities teaching method is found to be an effective method for improving pupils' achievement and retention, the mathematics teacher should accept it in teaching fraction in the primary schools. Mathematics teachers-in-training should be trained on the application of hands-on activities and serving teachers should employ the use of hands-on activities in teaching to enhance pupils' achievement and retention in fraction and other mathematics topics. Hands-on activities teaching/learning method is not gender sensitive therefore both male and female pupils should be involved in hands-on activities to enhance their achievement and retention in fraction. Hands-on activities require that, there should be standard laboratory and sufficient instructional materials. Schools should provide good laboratory, sufficient instructional materials for pupils to carry out necessary activities in fraction through hands-on activities. Also, workshops, conferences and seminars should be organized by Ministry of Education and other school administrators on the need for hands-on activities in the teaching of fraction in order to enhance pupils' achievement and retention.

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