IMPROVISATION AS A TOOL FOR ENHANCING STUDENTS' ACHIEVEMENT IN MATHEMATICS.

Abimbola NurudeenGbolahanAdeshina (Ph.D)[1], Bello Asma'u[2]and Joshua Jacob[3]

Federal College of Education (Technical) Gombe. Gombe state. [1,3] Federal College of Education (Technical) Gusau. Zamfara state.[2]

Abstract

Among all approaches aimed at reducing poor mathematics achievement, adoption of appropriate methods of teaching appears to be more rewarding. However, in all the methods, the importance of teaching materials can never be over – emphasized. In this study, improvisation of instructional materials was used as a tool to ascertain students' achievement in mathematics in secondary schools. The study adopted experimental design. Two research questions were asked while two hypotheses were formulated. The design involved students from senior secondary classes III. The study made use of experimental group and the control group. The experimental group was taught with instructional materials while the control group was taught without instructional materials. The instrument for data collection was an achievement test which comprised a 20 item multiple choice questions developed by the researcher and based on the selected contents of senior secondary mathematics curriculum which proved challenging for the students over the years. A t-test statistical analysis revealed that there is no significant difference in the pre-test administered to the two groups. It revealed that there is a significant difference in the post – test administered to the two groups. In the pre-test, the mean and standard deviation of the control group and the experimental group are 36.6, 38 and 12.5, 20.39. T-tab gives 1.67and $|t - cal|gives$ 0.32. *Since T-tab is greater than* $|t - cal|$*, the null hypothesis is accepted and we conclude that there is no significant difference between the two groups at the pre-test. in the post test, the mean and standard deviation of the control group and the experimental group are 37, 58.03 and 19.48, 15.04 respectively. T-tab is 1.67 and* $|t - cal|is$ 4.68. *T-tab is less than* $|t - cal|$*, hence, the null hypothesis is rejected and we conclude that there is a significant difference between the two groups in the post test. The study found that students taught with improvised instructional materials performed better in mathematics. Recommendations such as encouraging mathematics teachers to use improvised instructional materials in their mathematics classroom were made among others.*

Keywords : Senior Secondary School, Achievement, Improvised instructional materials.

Introduction

The study of mathematics generally is considered as basics for the preparation of every informed citizen and serves as a gateway to numerous career choices in life. D' Ambrosio (1997) stated that functional mathematics knowledge is the only true route to

entering the modern world. This may be why Soyemi (2005) opined that everybody uses mathematics in one way or the other in solving life problems. Nations that desire to forge ahead scientifically and technologically cannot afford to toy with the mathematical knowledge of her citizenry. This may be why stakeholders in mathematics education always show concern about the mass failure of students in this subject at the public examinations. Agwagah (2001) noted that mathematics teachers in most cases do not use improvised instructional materials in their mathematics classroom, so most of the mathematical concepts were taught abstractly. This may be because some of the mathematics teachers believed that instructional materials to be used for teaching these mathematical concepts are not in existence. Even when they are available, there is this complain of lack of money by the mathematics teacher in the market. This may be one of the factors responsible for students' continuous failure in public mathematics examination in Nigeria. Fanen (2005) stated that the availability and adequacy of instructional materials in schools for the teaching and learning of mathematical concepts were affected by several factors of which some are low level of educational funding in Nigeria, students' population explosion and even when provided, they are not related to the mathematical concepts being taught. It was observed that before now, governments (federal, states and local governments) have been taking the responsibility of providing some basic instructional materials, however, this is no longer so.

The Concept of Improvisation

When the real materials and equipments are not available, improvisation takes their place. This is to enhance the teaching-learning process and make the expensive nature of scientific equipment, the difficulty experienced in procuring them, and the excruciating and persistent problem of in-adequate funds less relevant in achieving the set objective (Paul *et al*, 2016). It is a fact that non provision of real materials and equipments have all combined to worsen the teaching of mathematics education in schools. But with well packaged and relevant improvisation, the arbitrary and complete abstract of the subject matter in the face of the learner is significantly reduced (Mohyuddin and Khalil, 2016). This also lends credence to the importance and essence of improvisation where and when the real instructional materials are not on hand.

Improvisation can be described as a substitute for an item, out of the materials that can easily be sourced for or available at the time. This means teachers' effort to supplement, substitute or device means, material and equipment to facilitate effective teaching and learning among the pupils (Bot, 2011). Improvisation and fabrication can be explained as composing a careful selection and use of material as an alternative means of complementing the existing or otherwise instructional materials /equipments in schools. Through improvisation, students' attention are captured and retained for the better part of the lesson. Since they serve as educational materials, students' interest in mathematics is stimulated, meaningful and interesting (Abimbola *et. al*, 2021). Learning is more permanent and there is development of skill in the psychomotor domain. The need for

improvisation becomes essential, whereas, has been the case in Nigeria. There is no adequate capital to procure the real materials and equipments in Nigeria. It is also necessary when population outweighs what is available because of the insufficient funding in education. Hence, due to gross inadequacy of materials / equipment meant to enhance the effectiveness of mathematics education in teaching and learning, many teachers develop a negative attitude towards the preparation and use of improvised and fabricated local equipments and materials. The negative attitude is reflected in the teacher's persistent preference for the moribund chalk and talk method to other forms of contemporary method of teaching.

Improvised instructional materials may be used as practical devices with which the students build accuracy, understanding and efficiency. According to Soyemi (2005), improvised instructional materials involve the act of producing and using alternative resources aimed at facilitating instruction. Abimbade (2004) noted that using improvised materials in mathematics classroom assist in the proper introduction of new skills, developing understanding, and showing the appropriate way of doing things. On this ground, Kurumeh (2006) observed that the utilization of improvised instructional materials takes adequate care of the three domains (Cognitive, Affective and Psychomotor), thereby reducing the abstractness of the mathematical concepts. The problem of students' poor achievement in mathematics has been a recurring decimal. This had necessitated consistent effort by stakeholders in mathematics education. Etukudo (2002) conducted a study on the effect of computer assisted instruction on gender performance of junior secondary school students in mathematics. This study was carried out in Rivers state, Nigeria. It adopted a quasi-experimental design with a population of 40 students (20 males and 20 females). It finally found that students' mathematics achievement is not dependent on gender. To contribute further, Eze (2005) investigated the effect of improvised instructional materials on primary school pupils' achievement in mathematics. This was conducted in Kano municipal public schools – Kano State. It also adopted quasi-experimental design. The study revealed among others that pupils in the experimental group achieved better than those in the control group. From the fore going, it is obvious that efforts have been put in place to reduce poor achievement in mathematics by students at various levels of education. These were done in various areas of mathematical concepts ranging from algebra, trigonometry to geometry. This has given room for this study to try the utilization of improvised instructional materials in the teaching of mathematics in secondary schools. However, Adebimpe (1997) and Daramola(2008) noted that improvisation demand adventure, creativity, curiosity and perseverance on the part of the teacher. Such skills are only realizable through well-planned training programme on improvisation.

Purpose of the Study

The main purpose of this study was to assert the efficacy of using improvised instructional materials on secondary school students in mathematics. Specifically, this study is aimed at:

1. Determining the extent of the use of improvised materials by mathematics teachers in secondary schools within Gombe metropolis.
2. Ascertaining the extent at which improvisation of teaching materials has enhanced teaching methods in mathematics.
3. Determining if improvised teaching materials have influenced students' attitude towards mathematics in secondary schools.
4. Determining if improvised teaching materials have influenced students' achievement in mathematics.

Significance of the Study

Any teacher who is concerned about his students is bound to give thought to anything that would help them learn. Education in general can only be successful with reasonable availability and proper selection of equipments and facilities. However, the fact remains that it is virtually impossible to purchase or make all the equipments and facilities required for sound and quality education available, especially in this part of the world. This makes it imperative for teachers to think of how best to use their manipulative skills to improvise to achieve their lesson objective

Instructional materials ensure that the learners see, hear, feel, recognize and appreciate as they learn. When the real material and equipments are not available, improvisation takes their place. This is to enhance the teaching- learning process as well as make the abstract nature of Mathematics, the phobia developed by students and difficulty in procuring them as well as the excruciating and persistent problem of in-adequate of funds less relevant in achieving the set objectives. It is a fact that non-provision of real materials and equipments have all combined to worsen the teaching of mathematics education in schools. But with well packaged and relevant improvisation, the arbitrary and complete abstract of the subject matter in the face of the learner is significantly reduced to lend credence to the importance and essence of improvisation where and when the real instructional materials are not available. The findings of this study are expected to benefit;

a) Secondary school teachers in assessing the potentials of improvisation of instructional materials in enhancing students 'curiosity for creativity, innovation, and use of learning resource within and outside the confines of the classroom.
b) Learners to interact with the improvised instructional materials around their environment.
c) Bridge gaps in course appraisals of contents, enrich existing curriculum and replace teacher-centered instruction with student-centered instruction.
d) Promote local sourcing of instructional materials, thus encouraging and sustaining creative and innovativeness among teachers and learners.

Research Questions

The following research questions have been formulated to guide this study.

1. Is there any significant difference in the pre-test achievement scores between the experimental and control groups?
2. Is there any significant difference in the post-test achievement scores between the experimental and control groups?

Research Hypothesis

Ho_1: There is no significant difference in the pre-test score between the experimental and control groups..

Ho_2: There is no significant difference in the post-test score between the experimental and control groups.

According to Igwe (2003), improvisation is the making or inventing of a piece of teaching equipment in emergency for the purpose of maximizing the use of the available resources. Improvisation is describable in the following instances:

a. When the improvised material would improve the lesson's effectiveness.

b. When the locally available materials are available for use.

c. When improvised materials would serve the same function as the standardized ones.

National teachers' Institute (2007) sees improvisation as a technique of originating a totally new tool, instrument, material device or modifying an already existing one for a particular purpose. Improvisation is a very important technique in all human enterprise. It can be very much refer to as resourcefulness and it is a very important aspect of our educational practice. Ofoefuna (1999) points out that we have two main types of improvisation.These are:

i. Improvisation by substitution; where an already existing local material is used in place of equipment that is not available.

ii. Improvisation by construction; in this case, a teacher constructs a new material entirely to teach his lesson when the required material or equipment is not available.

Need for Improvisation

In an ideal world, all science students would be taught in small classes and held in well-equipped laboratories. In the absence of those well- equipped laboratories, the place of practical activities cannot be over emphasized. Yet, those materials required for teaching of science are very much in short supply in total or partial absence (Adebimpe,1997).

Adequacy of the science teaching resources and gross inadequate finances, most especially for the purchase of science equipments, galloping inflation using enrolment of students, general downward trend in the nation's economy, poor maintenance culture and at times attitudes of some school heads towards science and science equipment, call for efforts at making science teaching and learning what it is supposed to be. The Nigeria school system today is experiencing a boost in population explosion, giving use to greater demand for classroom laboratory facilities and equipments with limited government resources, the teacher's ingenuity to improvise becomes tasking for learning to be effective and productive.

Advantages of Improvisation

Some advantages of improvisation according to Ofoefuna and Eya (1999) are:

1. It enables the learners and teachers make proper use of their environment. This is because in improvisation, we mainly make use of the available materials in the environment.

2. The use of local materials reduces cost in terms of financial expenditure in buying ready-made materials.

3. The development of resource materials for instruction can lead to discovery of new knowledge.

4. When parents, learners or the community members assist in improvising a resource material, this will improve school - community relationship.

5. They provide experience not easily obtained through other means and contribute to efficiency, depth and variety of learning.

6. Improvisation helps to bridge the gap between theoretical knowledge and practicability.

7. When the teacher and learners succeed in improvising an instructional material, there is a high sense of achievement and they are encouraged to higher exploits.

8. Talents in the students are discovered.

Disadvantages of Improvisation

A major problem militating against improvisation in Nigeria is lack of adequate professional training of staff. Improvisation demands adventure, creativity, curiosity and perseverance on the part of the teacher. Such skills are only realizable through well-planned training programmes on improvisation.

Another factor that would hinder the realization of the objectives of improvisation is lack of funds. Improvisation whether they cost less than standardized manufactured ones or not cost money, this money is usually not readily available to teachers. Improvisation can also expose teacher and students to some-hazards.

Mathematical Achievement

Mathematics is one of the formal disciplines that help man lay a solid foundation for future survival. Scientific and technological developments are dependent on mathematics. Ginsburg (2004) defines mathematics as a fundamental human activity of making sense into the world. Fapohunda (2002) sees mathematics as an essential tool in the formation of the educated man. In order to give a sound basis for scientific and reflective thinking and prepare students for the next level of education, its application in other disciplines, mostly in sciences, is appreciative and without it, knowledge of the sciences remains superficial. However, a considerable number of students have inadequate understanding of mathematics and mathematical concepts and skills(Akinsola and Olowojaiye, 2018).

Mathematics is used as a basic entry requirement into any of the prestigious courses such as medicine, architecture and engineering among other degree programmes. Despite the important role that mathematics plays in the society, there has been poor performance in mathematics in Nigeria national examinations. Several factors have been attributed to poor performance in mathematics, among which are poor methods of teaching (Harbour-peters, 2001).

Several studies have shown other indices that could affect students' mathematics achievement (Stringfield and Taddie 1991). The study of rural education in the U.S showed that classes and schools differ in terms of their learning environment and school resources. Okoyeocha (2005) in a comparative study of public and private schools opined that public schools are better equipped than their private counterparts. Trends in mathematics and science study (TIMSS) report of 2011 on mathematics result analysis showed that mathematics achievement is improving over the years in some member countries. The governments of many countries are struggling in considering how to provide best mathematics education for their students (Zalmon and Wonu, 2017). According to the report, students' ability in mathematics is deteriorating over their school years, as a student grows older, his mathematics competencies decrease. Identifying difficulties at an early age can prevent students from developing inappropriate strategies and misconceptions that can become long term obstacles to learning (Williams, 2008). Early intervention can also combat the development of anxiety, which can become a significant factor among older students. It can be assumed in most cases that if intervention starts early and specific weaknesses are concentrated upon, they might not need to be very long or intensive. Stringfield and Teddie (1991) reported in TIMSS that 4th grade students have much more positive attitude towards mathematics and this plays a crucial role in learning the subject, hence high achievement. Their report asserted that junior years are an important time of transition and growth in students' mathematical thinking. According to the report, during this time, the curriculum is changing in its content, sophistication, abstraction and expectations of students' proficiency. There is also move to abstract reasoning. Junior students begin to investigate increasingly complex ideas, building on their capacity to deal with more formal concepts.

Research Design

The design of the research is an experimental type. It involved students from senior secondary classes. The study divided the students into experimental and control groups. The experimental group was taught with instructional materials while the control group was taught without instructional materials. The population of the study consists of 60 senior secondary school III students from a class. Simple random sampling was carried out to select the experimental and the control groups. The instrument for data collection was an achievement test which comprised a 20 item multiple choice questions developed by the researcher and based on the selected contents of senior secondary mathematics curriculum which proved challenging for the students over the years . Both groups were given the pre-test and the post-test.

Population of the Study

The scope of the study is the senior secondary school II students of Gombe metropolis. For the purpose of getting a group of the same characteristics for the experiment, a single class in a school is used for the study. The class contains 60 students and was divided into two groups. 30 students are in the experimental group and 30 students are also in the control group.

Instruments for Data Collection

Research instruments used for data collection for this study included a 20-items improvisation of mathematics tool tests which was administered at a pre-test and later post-test. The test questions were constructed by the researchers and vetted for use by some experts in mathematics education. The pre-test and post test were administered to the senior secondary students in the experimental and control groups. The results from these test constituted the data for the study and it was analyzed.

Method of Data Analysis

Mean, standard deviation and the student t-test were used for the analysis of the data collected. The mean and the standard deviation were used to answer the research questions, while the t-tests were used to take decisions on the hypotheses at 0.05 level of significance and $n_1 + n_2 - 2$ degree of freedom.

Formula for calculating t-test is given by

$$\text{T-test} = \frac{\overline{X}_1 - \overline{X}_2}{\sqrt{\frac{S_1^2}{N_1} + \frac{S_2^2}{N_2}}}$$

Where

$\overline{X_1}$ =Mean of the first group, X_2 =Mean of the second group, S^2_1 = Standard deviation of the first group, S_2^2 =Standard deviation of the second group, N_1 = Sample size of the first group, N_2 = Sample size of the second group

Result of Data Analysis

Ho$_1$: There is no significant difference in the pre-test score between the experimental group and the control group.

Table 1: Comparison of the Pre-test result of the Control and Experimental group

Group	Nos of students	Group mean	Standard deviation	Degree of freedom	t-tab	t-cal	Remark
Control	30	36.6	12.5				Not
				58	1.67	-0.32	Significant
Experimental	30	38	20.39				

From the result of the pre – test shown in table 1 above, the number of students in each group is 30. The mean of the control group is 36.6 and that of the experimental group is 38. The standard deviation of the control group is 12.5 and that of the experimental group is 20.39. The degree of freedom in this distribution is 58 and$|t - cal|$gives 0.32. The t-tab gives 1.67.

Ho$_2$: There is no significant difference in the post-test score between the experimental group and the control group.

Table 2: Comparison of the Post-test result of the Control and Experimental group

Group	Nos of students	Group mean	Standard deviation	Degree of freedom	t-tab	t-cal	Remark
Control	30	37	19.48				
				58	1.67	-4.68	Significant
Experimental	30	58.03	15.04				

Table 2 above shows that the number of students in both the control group and the experimental group is 30 students each. The mean of the control group is 37 while that of the experimental group is 58.03. The standard deviation of the control group is 19.48 and the standard deviation of the experimental group is 15.04. The degree of freedom is 58. $|t - cal|$ gives 4.68 and t-tab gives 1.67. T-tab is less than$|t - cal|$, hence, the null hypothesis is rejected and we conclude that there is a significant difference between the two groups.

Discussion of Findings

The primary objective of this study was to see whether using improvisation as a tool will enhance students' achievement in mathematics.. Considering the analysis of the first hypothesis, the mean of the control group is 36.6 and that of the experimental group is 38. The standard deviation of the control group is 12.5 and that of the experimental group is 20.39. The degree of freedom in this distribution is 58 and $|t - cal|$ gives 0.32. The t-tab gives 1.67. T-tab is greater than $|t - cal|$. Hence, the null hypothesis is accepted and we conclude that there is no significant difference between the two groups at the pre-test.

Considering the analysis of the second hypothesis, the mean of the control group is 37 while that of the experimental group is 58.03. The standard deviation of the control group is 19.48 and the standard deviation of the experimental group is 15.04. The degree of freedom is 58. $|t - cal|$ gives 4.68 and t-tab gives 1.67. T-tab is less than$|t - cal|$, hence, the null hypothesis is rejected and we conclude that there is a significant difference between the two groups.

Furthermore, the mean of the control group did not really change at the pre-test and post-test. At pre-test, it was 36.6 and 37 at the post-test. However, the mean of the experimental group at the pre-test is 38 and 58.03 at the post-test. The findings of this study confirm the fact that the improvised materials utilized in teaching the experimental group aided the mathematics achievement of the students in the group.

Conclusion

From the findings of the study, it can be seen that students taught with instructional materials performed better than those taught without it. This shows that students learn and perform better when they are taught with instructional materials because the use of improvised instructional materials gives the students the opportunity to see, feel and touch the materials during teaching.

The place of improvised instructional materials in the effective implementation of any education programme cannot be undermined. Instructional materials perform such functions as the extension of the range of experience available to learners, supplement and complement the teacher's verbal explanations thereby making learning experience richer and providing the teacher with interest into a wide variety of learning activities. Improvised Instructional materials supplement, clarify, vitalize, emphasize instruction and enhance learning in the process of transmitting knowledge, ideas, skills and attitude. This calls for teachers' resourcefulness and improvisation on the parts of the mathematics teachers. The ability of the teacher to make use of "local" materials in place of "standard" ready-made materials makes lesson more effective and improved students' achievement.

Recommendations

Based on the findings and conclusion made above, the following recommendations are hereby suggested:

1. There is the need for teachers to be resourceful in instructional materials selection, improvisation if needs be and utilization. This is to reduce the cost of production

and maintenance of instructional materials, especially the improvised ones. Thus, regular training and re-training of teachers is hereby recommended on the improvisation.

2. There is need for the development of positive attitudes by teachers towards the use of improvised instructional materials for their students. This will encourage the development of their proficiency.
3. School heads, Principals and officials of the Ministry of Education should ensure regular supervision to enhance effective use of improvised instructional materials and resources in the teaching of mathematics in secondary schools.
4. Enough time should be allotted in the school time table for effective use of improvised instructional materials in teaching mathematics.
5. Teachers and students should be encouraged to form the habit of improvising instructional materials to make up the shortfall in supply.
6. Conferences and workshops should be organized for pre – service and serving teachers so as to popularize the effectiveness of improvisation of teaching materials in the enhancement of students' achievement in mathematics.

References

Abimbade C.T (2004). *Effective Primary School Science Teaching: Meaning, scope and strategies*. LECAPE Publishers. Jos.

Abimbola N. G. A, Okechukwu I. E and Asmau B (2021). Effects of Teaching 2 and 3 Dimensional Shapes, Using Cooperative Learning Approach. *Abacus*: *The Journal of Mathematical Association of Nigeria*. 46(1). 222-230.

AdebimpeA.O (1997). *Improvisation of Science Teaching Resources*. Proceedings of 40th Annual Conference of STAN. pp:55-60.

AgwagahU. N.V(2001). *Teaching number bases*. Proceeding of science teachers' Association of Nigeria. Pg: 125-127

Akinsola M. K and Olowojaiye F. B (2018). Teacher's Instructional Methods and Student's Attitude Towards Mathematics. *International Electronic Journal of Mathematics Education*, 3(1). 60-73

Bot T. D (2011). Student's Attitude Towards Problem Solving and Achievement in Mathematics A Study of Selected Senior Secondary Schools in Jos, Plateau State. African Journal of Science, Technology and Mathematics Education, 1(1).

D' Ambrosio U. (1997). *Ethnomathematics and its place in the History and pedagogy of mathematics*-New York: State University of New York press.

Daramola, S.O. (2008). *Mathematics Cognition and Students' Choice of Physics in Kwara*

State. Proceedings of 40th Annual Conference of STAN.

Etukudo U. E (2002). *The effect of computer assisted instrumentation in gendre and performance of junior secondary school students in mathematics*. Proceedings of 40th Annual Conference of MAN.

Eze A. F (2005). *Promoting self control of mathematics learning for pre-service primary teachers*. Australia: University of Melbourne.

Fanen S. U (2005).*Improvising inscience teaching philosophyand practice*. Abakiliki, Belpot (Nig) limited.

Fapohunda, O.M. (2002). *Educational Computing: Learning With Tomorrow's Technologies*. Ibadan: University Press.

Ginsburg H.P. (2002). *Little Children, Big Mathematics: Learning and Teaching in the Pre-School.*Proceeding of the 26th Conference of the International Group For The Psychology Of Mathematics Education. (Pp. 3-14).

Harbor-Peters V. F (2001).*Unmasking some aversive aspect of school mathematics and strategies for averting them*. Inaugural lecture.

Igwe. T. (2003). *Enriching Science Education, the place of improvisation in the classroom*. Proceedings of 41st Annual Conference of STAN Science teachers' Association of Nigeria (STAN).pg: 51-53

Mohyuddin R. G, and Khalil U (2016). Misconceptions of Students in Learning mathematics at Primary level. *Bulletin of Education and research*, 38(1), 133-162.

National Teachers' Institute (2007). *Improvisation of instructional materials* published by NTI press, Kaduna.

OfoefunaM.O and Eya P.E. (1999). *The basis of educationaltechnology.* J. T.C publishers, Enugu.

Okoyeocha A.C (2005).*A Comparative Study Of Public And Private Secondary Schools In the Provision of Quality Education.* Nigerian Journal Of Educational Administration and Planning 5:88-95

Paul K. L., Adisah-Attaa I, Asamoah A. S, and Nasmah K. A. N. (2016). Effective classroom management, self esteem and academic achievement. *International Journal of Social Science and Humanities Research,* 4(1): 292-299.

Soyemi T (2005). *In the classroom with behavioral modification*. The school councilor pp: 110-113

Stringfield S. and Teddie C (1991).*School Classroom And Student Level Indicators Of Rural School Effectiveness*. Journal of Research In Rural Education. 3:15-28

Zalmon I. G and Wonu N. (2017). Comparative Analysis of Student's Mathematics Achievement in West African Senior Secondary Examination in Nigeria. *European Journal of research*

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