# EFFECTIVENESS OF STANDARD AND IMPROVISED INSTRUCTIONAL MATERIALS ON STUDENTS' PERFORMANCE IN MATHEMATICS

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Abstract

*The study examined effectiveness of standard and improvised instructional materials on students' performance in Mathematics. The study adopted quasi- experimental design with a sample of 74 students selected for the study. Mathematical Achievement Test (MAT) was used to collect data after the validation. Reliability coefficients of 0.68 was obtained. Data collected were analyzed descriptively and inferentially for the research question raised and the hypotheses formulated and tested at 0.05 level of significance. The findings of the study showed that there is a significant difference in the performance of mathematics students taught using standard and improvised instructional materials compared with the conventional method. Also, male students performed better than their female counterparts in this study. Based on the findings of the study, it was recommended that standard and improvised materials should be effectively used in teaching of Mathematics in secondary schools.*

Keywords: *Standard, improvised, instructional materials, students' performance*

## Introduction

Mathematics is the science of reasoning and computations. It is the science of numbers, quantities, shapes, spaces and their relationship. It deals with generalizations, abstractions and application of ideas to situations in the real life. Mathematics has become a language that helps man to describe ideas and drawn conclusion from his environment, which enables him to make scientific predictions, thereby transforming the invisible to the visible, through intuitive, logical and critical thinking for solving problems that would have been impossible in other subjects. As a result, mathematics teachers present mathematics knowledge to their students as a necessity right from pre-primary, primary, post-primary to tertiary level. Mathematics is a vital beckon for societal reality and personality development of a learner. Kolawole and Oginni, (2009) described Mathematics as compulsory subject for all primary and secondary school students, that must be passed before admission could be offered into any tertiary institution in Nigeria.

Activities of Mathematics teachers over the years has shown their excessive use of words to convey ideas, knowledge or facts in the

teaching-learning process. This in turn has resulted into abysmal performance of students in the subject. Several strategies are being put in place to ameliorate the problem by researchers but have not yielded the expected results. Akanmu and Fajemidagba (2016) laid emphasis on helpful strategies that can contribute positively to learners' ability to extract a simple figure from a complex one. This would be effective, more interactive and eventually make the teaching-learning of mathematics an interesting and activity – based for the students.

Instructional materials are the tools that facilitate teaching learning process. These materials compliment teachers' efforts in concretizing and practicalizing instructions and eventually promote students understanding of concepts. Any serious teacher who has the interest of the students at heart expected to look for improvised materials if it is impossible to get standard materials during teaching and learning process. The act of teaching Mathematics without using any instructional device can never erase the abstract impression that the majority of the students have towards Mathematics. Since the subject is practical in nature, every teacher needs tool in educational lessons, which could make learning more permanent. Instructional Materials are the collection of materials including living and non living resources that a teacher may use in teaching and learning situations to help achieve her objectives. This includes power point presentations, books, articles, manipulative and visual aids. Instructional materials make learning more exciting, interesting and interactive.

Instructional materials constitute alternati ve channels of communication, which a te acher can use while explaining more vividly instructional information to learners. (Amadioha, 2009). Instructional materials can be in different forms such as textual and non-textual, the visual, the auditory and audio-visual. Instructional materials refer to the facilities that can be used to ease, encourage, improved and promote teaching and learning activities.

*Type of instructional materials*

Classroom experiences help teachers to become conversant with the right type of materials to be used in teaching/ learning situations. Types of instructional materials outlined by Amadioha (2009) are graphic materials, three- dimensional materials, still pictures, still projected pictures, motion pictures and Audio materials. Nowadays, knowledge dynamism helps teacher to teach with devices that promotes graphics, animation on computer. Akanmu and Fajemidagba (2014) advocated interactive and dynamic classroom experience as a panacea to knowledge driven mathematical understanding that can sustain learners' interest in the subject. Dynamic teaching could employ the use of graphic materials that are used to compress information, to focus and captivate attention, to vary stimuli presented and as an aid to recall.
Other instructional materials in mathematics and its pedagogical uses are stated below:

*Grid board*: - for the teaching of perimeter and area of plane figures, coordinate system, graphing functions

*Modified geoboard* :- for the teaching of plane figures, similarity, coordination, counting, right angles, pattern, classification, scaling, position, congruence, area, perimeter

*Fraction slider:*- for the teaching of addition and subtraction of fraction

*Number slider*:- for the teaching of addition and subtraction of integers

*Algebra Tiles*: - for the teaching of number slider, modelling expression, solving quadratic equation, simplifying trinomials and polynomials

*Fraction pie*: - for the teaching of fraction, circumference of a circle, area of a circle, area of a circle, perimeter of a parallelogram

*Perimeter and Area*: - for the teaching of distance, polygons, perimeters of polygons, area of polygons

*Platonic solid*: This refers to regular polyhedral such as tetrahedron, hexahedron or cube, octahedron, dodecahedron, Icosahedron, sphere

*Archimedean Solid*: for the teaching of volume, surface area, tessellation, polygons

*Number line:* - for the teaching of counting, measurement, addition and subtraction, decimal and fraction

Standard instructional materials looks fascinating and more inviting. This could be in form of graphic materials, information Technology (IT) and other devices that are 21st century compliance. Nufus and Zubainur (2020) emphasized the use of standard materials that could enhance students' mathematical understanding ability. By using model, diagram, and symbols to present a concept; changing a representational to concrete. Graphics communicate facts and ideas clearly through combination of drawings, words and pictures. Oginni (2021) reiterated that graphic organizers help students to solve knotty issues as well as enhance test scores through effective and consistent problem-solving process in Mathematics.

Improvisation is the alternative material at our disposal that can be used in place of the standard materials, which are not available or expensive, delicate or sophisticated. In a situation where a readymade materials are not in place, it is expected of any professional mathematics teacher to demystify abstraction in the teaching of the subject. According to Onasanya and Omosewo (2011) creative minds are curious in expanding their academic horizon through the provision of alternative teaching tools. Improvisation is the make-shift of a learning material. Ikwuka & Chukwuemeka (2016) emphasized that improvisation of instructional materials has become a better substitute that promote comprehension and assimilation of facts.

Statement of the Problem

Many teachers are complaining of not providing them with sophisticated equipment to teach their students without

exploring locally available materials at their disposal, as an alternative impetus for the grossly unavailable standard materials in our schools. It appears that the environmental necessity in checking unavailability of teaching aids has not been priotised by Mathematics teachers, thereby leaving their students to theoretical knowledge transfer. It has been noticed that many students do not intentionally hate mathematics, but as a result of the abstract symbolism attached to most concepts by some teachers. Also, the researchers noticed poor performance of students in internal examination, hence the need for investigating into the effectiveness of different materials in the teaching of the subject.

Purpose of the Study

The purpose of the study is to investigate the effectiveness of standard and improvised instructional materials on the academic performance of students in Mathematics: Specifically, the study would:

-find out the instructional materials that can enhance mathematics learning

-investigate the gender difference and instructional materials effectiveness

Research Question

A research question was raised to guide the study.

1. What is the effect of standard and improvised material on student performance in Mathematics?

Research Hypotheses

The following hypotheses were generated for the study:

1. There is no significant difference in the pretest mean scores of students before their exposure to standard materials, improvised materials and conventional strategies.
2. There is no significant difference in the posttest mean scores of students exposed to standard materials, improvised materials and conventional strategies.
3. There is no significant difference in the performance mean scores of male and female students exposed to standard materials , improvised materials and conventional strategies before and after the treatment

Methodology

The research design employed for this study was pretest, posttest and control group quasi experimental design.

$G_1$:- $O_1$ $X_1$ $O_2$

$G_2$:- $O_3$ $X_2$ $O_4$

$G_3$:- $O_5$ C $O_6$

Where $G_1$ = Experimental group 1,

$G_2$ = Experimental group 2 and

$G_3$ = conventional group

$O_1$, $O_3$, $O_5$ are the pretest observations and $O_2$, $O_4$, $O_6$ are the posttest observations

$X_1$ - Treatment for group 1 (Standard instructional materials)

$X_2$ - Treatment for group 2 (Improvised instructional materials)

C -- Control group (conventional method)

The population for this study consisted of all Senior Secondary School I (SS1) in three schools in Ondo state. The sample for this study comprised 74 Mathematics students selected using multistage sampling procedure. Firstly, 3 schools were randomly selected from a local government in the state. Secondly, Art classes were purposively selected from each of the schools, this is because of their phobia for Mathematics and to test the efficacy of the experiment. The last stage involved the use of intact class of a single arm of SS1 from each of the selected schools. Mathematical Achievement Test (MAT) was the instrument used to collect data for the study. Some of the topics consider were Geometry, Measuration and Algebra while standard and improvised materials were provided for *Modified geoboard*, *Fraction slider, Algebra Tiles and Number line.* The face and content validity of the instrument was carried out through four experts in Mathematics education, with inter-rater rating of 0.88. The reliability coefficients of 0.79 was obtained when test re-test method was used to ascertain the reliability of the instrument. Mathematics Achievement Test consists of section A and B, section A consist of bio-data of the respondents which include the name of the school, students' identification number, and sex. Section B consist of 30 objectives items. The same items were used for both pre-test and post-test for data collection. MAT used for pre-test was reshuffled for the post-test in order to prevent carry-over effect. Data collected were analyzed descriptively and inferentially using mean, standard deviation, Analysis of Variance (ANOVA), Analysis of Covariance (ANCOVA), Scheffe posthoc, Multiple Classification Analysis (MCA) for the research question raised and the hypotheses formulated and tested at 0.05 level of significance

Results

Research Question

1. What is the effect of standard and improvised material on student performance in Mathematics?

*Table 1:- Frequency counts and mean performance of students in Mathematics*

| Group | N | Pretest mean | SD | N | Posttest mean | SD | Mean Diff. |
|---|---|---|---|---|---|---|---|
| Standard | 24 | 6.83 | 2.01 | 24 | 27.38 | 5.79 | 20.55 |
| Improvised | 20 | 6.45 | 1.76 | 20 | 44.65 | 5.12 | 38.20 |
| Conventional | 30 | 6.70 | 2.25 | 30 | 17.70 | 3.53 | 11.00 |

Table 1 showed the mean differences of the three groups, where the 20.55, 38.20 and 11.20 were recorded for the standard, improvised and the conventional group respectively. It appears as if the students taught using improvised instructional

materials perform better than their counterparts that were taught with standard instructional materials and the conventional group.

Hypothesis 1: There is no significant difference in the pretest mean scores of students in standard, improvised and conventional strategies.

*Table 2:- ANOVA summary of students mean scores in standard, improvised and conventional groups before treatment*

| SOURCE | SS | Df | MS | F | P |
|---|---|---|---|---|---|
| Between groups | 1.633 | 2 | 0.816 | 0.194 | 0.824 |
| Within groups | 298.583 | 71 | 4.205 | | |
| Total | 300.216 | 73 | | | |

Table 2 showed that Fcal = 0.194, P value > 0.05 was not significant. The null hypothesis is not rejected, this implies that there is no significant difference in the pretest mean score of the students before their exposure to standard, improvised and conventional strategies. This indicated a homogeneity in their performance, and hence any changes thereafter could be as a result of the treatment.

Hypothesis 2: There is no significant difference in the posttest mean scores of students exposed to standard, improvised and conventional strategies.

*Table 3:- ANOVA summary of students mean scores in standard, improvised and conventional groups after treatment*

| SOURCE | SS | Df | MS | F | P |
|---|---|---|---|---|---|
| Between groups | 8735.43 | 2 | 4367.72 | 190.20 | 0.000 |
| Within groups | 1630.48 | 71 | 22.964 | | |
| Total | 10365.91 | 73 | | | |

Table 3 showed that Fcal = 190.20, P value < 0.05 was significant. The null hypothesis is rejected, this implies that there was significant difference in the posttest mean score of the students exposed to standard, improvised and conventional teaching. In order to locate the sources of pairwise significant difference among the groups, Scheffe Posthoc test was carried out. The result is presented in Table 4.

Table 4:- Scheffe Posthoc analysis of students *in standard, improvised and conventional groups after treatment*

| Groups | 1 | 2 | 3 | N | Mean |
|---|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| Standard (1) | * | * | 24 | 27.38 |
| Improvised (2) | | * | 20 | 44.65 |
| Conventional (3) | | | 30 | 17.70 |

Table 4 showed that there was significant difference between the performance of students taught using standard and improvised materials. Similarly, the mean difference between the performance of students taught with improvised materials is more significant than that of standard. The reason adduced to the improvement in the performance of students taught using improvised strategy over their counterpart in standard strategy could be as a result of locally invented materials that students are familiar with, which they participated in its build up during the experiment. Which gives opportunity for the students to search for familiar tools within their domains for continuous practices on how to use improvised items during and after class.

*Hypothesis 3*:- There is no significant difference in the performance mean scores of male and female students exposed to standard, improvised and conventional strategies before and after the treatment

Table 5:- *2x3 ANCOVA summary of gender difference performance in Mathematics when taught using standard, improvised and conventional*

| Source | SS | df | MS | F | P |
|---|---|---|---|---|---|
| Corrected Model | 9067.47* | 6 | 1511.24 | 77.980 | .000 |
| Covariate (Pretest) | 122.30 | 1 | 122.30 | 6.311 | .014 |
| Sex | 108.71 | 1 | 108.71 | 5.609* | .021 |
| Group | 8696.92 | 2 | 4348.46 | 224.382* | .000 |
| Sex*Group | 176.02 | 2 | 88.01 | 4.541* | .014 |
| Error | 1298.440 | 67 | 19.38 | | |
| Total | 68887.00 | 74 | | | |
| Corrected Total | 10365.916 | 73 | | | |

Table 5 showed that $F_{cal}$ = 4.541, P value = 0.014 < 0.05 was significant. The null hypothesis is rejected, which implies that there was a significant difference in the performance mean scores of male and female students exposed to standard, improvised and conventional strategy before and after treatment. Similarly, the main effect of gender ($F_{1, 67}$ = 5.609, P < 0.05) and treatment ($F_{2, 67}$ = 224.382, P < 0.05) on the students' performance in Mathematics is statistically significant at 0.05 level of significance in each case. In order to determine the effectiveness of the treatment at enhancing students performance in Mathematics based on gender, multiple classification was used. The result is presented in Table 6.

Table 6:- Multiple classification Analysis *of students' performance in Mathematics when taught using standard, improvised and conventional based on gender*

| Variable+ category | N | Unadjusted Devn' | $Eta^2$ | Adjusted for Independent + Covariate | Beta |
|---|---|---|---|---|---|
| Standard | | | | | |
| Male | 14 | 2.19 | | 2.19 | |
| Female | 10 | -3.08 | | -3.08 | |
| Improvised | | | | | |
| Male | 11 | 1.35 | | 1.25 | |
| Female | 9 | -1.65 | 0.72 | -1.54 | 0.06 |
| Conventional | | | | | |
| Male | 14 | -0.34 | | -0.75 | |
| Female | 16 | 0.30 | | 0.66 | |
| | Multiple R | Multiple $R^2$ | | Grand Mean | |
| Standard | 0.002 | 0.000 | | 27.38 | |
| Improvised | 0.328 | 0.107 | | 44.65 | |
| Conventional | 0.398 | 0.158 | | 17.70 | |

Table 6 revealed that male students exposed to standard instructional materials and improvised instructional materials had the higher mean scores in Mathematics than their counterparts that are exposed to conventional method. In standard instructional materials, the mean score for the male is 29.57 while the female mean score is 24.30. In improvised instructional materials, the mean score for the male is 45.90 while the female mean score is 43.11. However, in the conventional instructional strategy, the mean score for the male is 16.95 while the female mean score is 18.30. The treatment and gender explained about 72% ($Eta^2$ = 0.72) of the observed variance in students' performance in Mathematics.

The findings of the study showed that there is a significant difference in the performance of mathematics students taught using standard, improvised and the conventional strategies. This supported the study of Amadioha (2009) that instructional materials definitely make learning more real and meaningful to the learner. The findings also revealed that the students taught using improvised strategy performed better than those taught with the standard strategy. This could be due to the extra efforts made by the students to fetch for the materials in their local environment. The finding is in consonant with the earlier work of Owolabi and Oginni (2012) that there were significant difference in the performance of those students that were in the improvised classes and non-improvised classes. The findings is in line with the work of Olatunbosun et.al (2020) that the interest of the learner is captured and held during the process of improvisation and so will cause them to be able to create and improve on their own ideas.

The findings also revealed that male students taught using standard materials and improvised instructional materials performed better than their female counterparts except in conventional class where the female perform better than their male counterparts. The findings contradicted the work of Ikwuka, (2016) that there is no significant difference in the academic achievement of SS2 male students with mean score of 24.00 and female students with mean scores of 23.67 who were taught Mathematics with improvised instructional materials. Ikwuka (2016) reiterated that gender has no effect on the experimental group who were taught Mathematics with improvised instructional materials.

## Conclusion and Recommendations

Conclusively, instructional materials make learning more real and meaningful to the learner. The materials should not be substituted for learning but must contribute to the learning process itself. It is not out of place to popularize the use of local materials in the teaching of Mathematics, even tasking the students in building some of these local materials could as well facilitate better learning outcome in Mathematics. Instructional materials should be useable and not so complex to use them. Instructional materials to be used must make learning more real and meaningful to the learner.

Based on the findings of the study, the following recommendations were made: Mathematics teachers should try to improvise instructional materials in the teaching and learning of Mathematics in secondary schools and Government should try to provide funds to secondary school Mathematics teachers to enable them improvise instructional materials for teaching Mathematics.

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