COMPARATIVE EFFECT OF IMPROVISED AND STANDARD INSTRUCTIONAL MATERIALS ON SECONDARY SCHOOL STUDENT'S ACADEMIC PERFORMANCE IN BIOLOGY IN ILORIN, NIGERIA

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Abstract
This paper examined the effects of standard instructional materials and improvised instructional materials on secondary school students' academic performance in Biology in Ilorin, Nigeria. Forty five (24 male and 21 female) SS1 students from three secondary schools in Ilorin, Kwara State Metropolis made-up the sample. Standard instructional materials (SIM) and improvised instructional materials (IIM) for teaching biology concepts was determined using Pretest – Posttest experimental group design. The reliability coefficient of Biology Performance Test was 0.84 using Kuder-Richardson (KR-21) formula. The schools were randomly assigned to two experimental groups and control group. The experimental groups were taught selected concepts of biology using SIM, IIM, while traditional method was used for the control group. Results revealed that the students taught with SIM performed better than IIM and control groups respectively. The SIM and IIM were found also to be gender friendly. Based on the findings, recommendations were made.

Keywords: improvised instructional materials; standard instructional materials; biology; gender academic performance.

Introduction

Biology is a branch of natural science for study plants and animals in relation to their environment. Diseases of plants and animals are also studies so that curative and preventive measures can be adopted to enhance the health of these living things (Gambari, Yaki & Olowe, 2013). The importance of Biology cannot therefore be over emphasized, as scientific discoveries need to be understood and appreciated as a way of life. Teaching and learning of Biology at the secondary school level require a lot of handling of equipment and materials by students in order to make the learning meaningful and worthwhile. However, the depressed state of Nigeria economy made it too exorbitant to purchase many of these equipment and materials and this led to improvisation of such equipment and materials (Daramola, 2005).

Biology remained one of the most interesting but difficult subjects in the school curriculum (Gambari, Yaki & Olowe, 2013). West African Examination Council (WAEC) chief examiners' report revealed that the performance of Nigeria students in Ordinary Level Biology was generally poor (WAEC, 2011, 2012 & 2013). One of the factors responsible for poor performance is lack of instructional materials for teaching biology concepts at senior secondary school level in Nigeria. The teaching of Biology should be based on students' environment and this call for the use of instructional materials, which could be locally produced (improvised), or the use of standard instructional materials. Improvisation is the act of bringing in novelties or making changes. It is the act of using alternative materials or resources to facilitate instruction whenever there is lack or shortages of some specific first hand instructional material. James (2007) defined improvise as the production of equipment from simple inexpensive locally available materials a substitute for the unavailable expensive conventional equipment (Standard Instructional Materials) by the teacher.

Improvisation in science teaching is probably as old as experimental science. A more systematic approach to improvisation in science was improved in response to the acute shortage of laboratory equipment after the world war (II) to help needy schools in war torn countries improvise their equipment needs (UNESCO source book title" suggestions for science teachers in devastated countries").

In teaching biology effectively, the use of instructional materials and equipment are needed. Science concepts can be taught effectively with different types of models and Pisces of apparatus. The materials play vital roles in the teaching of Biology in that they arouse the interest of students during teaching and learning processes, they extend large number of students to be taught at a time, they enhance the total participation of the students in class and also they make teaching less monotonous. Therefore, Biology is best taught in secondary schools with the use of teaching aids and materials so as to realize the above advantages (Gambari, Yaki & Olowe, 2013).

In the teaching of Biology, almost everything can be improvised. For instance, chromosomes, gene pool and DNA model can be made from grains glued with plastering. In ecological studies an aquarium can be made from any moderate size wide mouthed glass containers. Insect net cab be constructed form a circular stiff wires to which a small wooden pole is attached with mosquito netting materials as the net. Also living animals' cages for keeping a few living animals in the laboratory can be made from empty boxes or a stiff wire made into a box. Thus, the teacher's professional commitment, creativity, ingenuity and imaginative ability are all indispensable towards effective improvisation of Biology materials. When Biology is taught in rooms in which there are no facilities of electricity supply and gas supply, lanterns and stoves can be used as substitutes (Balogun, 2008).

In addition, glassware is no doubt expensive especially when breakage is high; as a result, there is now a move towards alternative with plastic wares e.g. plastic basin or bucket replacing through and watch glass. Since many materials needed in teaching Biology occur abundantly in the environment, it is argued that the materials needed have to be improved in the absence of standard' instructional materials for effective teaching to take place. Improvisation of science materials has been known for quite some time to science educators (Akinsola, 2000).

In Nigeria schools, chalk and talk method of teaching is commonly used by teachers which is no longer effective with the modern day teaching and learning of science. The use of instructional materials provides first-hand experiences that are acquired through the sensory organs of sight, smell, touch, taste and learning. It has been found that these sensory organ do not function at the same level in all children (Nwaorgu, 2007). Emphasis should be placed on the use of different types of instructional materials that could stimulate as many senses as possible in the science classes. When relevant standard instructional materials are used in the classroom work, the rate of assimilation by the students will be greatly enhanced (Gambari & Gana, 2005).

Several Researches had shown that instructional materials enhanced students' performance than traditional method of teaching (Gambari, Yaki & Olowe, 2013; Ibrahim, 2008; Nsofor, 2006). However, research findings in gender have been inconclusive. The results of Tolu (2009) and Umar (2011), revealed that there is no significant difference in the performance of male and female students in biology concepts, while Kuta (2010) reported that male students performed better than their female counterpart in biology concepts.

It should be noted that the instructional materials aids cannot substitute the teacher rather the teaching could be made more effective and more meaningful through the effective use of instructional materials. More so, the standard instructional materials (SIM) and improvise instructional could improve students understanding of biology concepts. Therefore, this study examined effect of standard and improvised instructional materials on secondary school student's academic performance in Biology in Ilorin, Nigeria.

Research Hypotheses

(i)   There is no significant difference in the performances of students exposed to standard instructional materials, improvised instructional materials and those taught with traditional method.

(ii)   There is no significant difference between the male and female students exposed to standard instructional material.

(iii)   There is no significant difference between the male and female students exposed to improvised instructional material.

Methodology

The research design adopted for this study was pretest, posttest experimental group design. Senior secondary class one (SS1) students from the sampled schools were assigned to the experimental conditions namely: improvised, standard and control groups. The groups were pre-tested using the same instrument. Then, the experimental groups were exposed to treatment. Table 1 shows the design layout.

Table 1: The design layout

Group Pre-test	Pre-test	Treatment	Post-test
Experimental I	O_1	X_1	O_2
Experimental II	O_3	X_2	O_4
Control Group	O_5	X_o	O_6

The interpretations of the design are as follows:

O_1 = Pretest scores of the experimental group (1)

O_2 = Pretest scores of the experimental group (2)

O_3 = Pretest scores of the control group

O_4 = Post test scores of the experimental group (1)

O_5 = Post test score of the experimental group (2)

O_6 = Post test scores of the control group

X_o = No Treatment

The independent variables in this study are the standard instructional materials, improvised instructional materials and conventional method of teaching. The dependent variable is the students' scores. All the secondary schools in Ilorin, Kwara State constitute the target population of the study. Three schools were randomly sampled from 237 secondary schools in Ilorin, Kwara State. The sample comprised of Forty five students (24 male and 21 female) from SS1 class. The schools were randomly assigned to three groups (improvised, standard and control). Each group comprised of fifteen students.

The justification for the selection of SS1 students is based on the fact that two units of Biology (the blood circulatory steps and structures shapes of mammalian blood) for instruction considered in this study were taught in SS1. The instrument employed in this study was a researcher designed Biology Performance Test (BPT). The PTB consists of 20-item, multiple choice objective test of four options (A-D). The test items were carefully drawn to ensure that the items fall within both the scope of the SS1 syllabus, and the specific areas were selected for the purpose of this study. The PTB measured the performance of students at both pre-test and post-test.

The BPT was validated by experts from Science Education Department, University of Ilorin and its reliability coefficient determined as 0.84 using Kuder Richardson (KR-21). The study lasted for three weeks. The objectives and the modalities of the experiments were specified and operational guide was produced before the commencement of the treatment.

Two concepts of Biology were taught using the following procedures:

(i) ***Experimental groups 1 (improvised group):-*** This group were taught the concepts using improvised instructional materials. The students were asked to collect different sizes of orange balls or any similar round seeds and sticks of pencil thickness. The students will were also asked to bring a cardboard paper each. The Biology teacher together with the researcher used the orange balls of different sizes to build Hearteria models of mammalian heart of hear with synthetic, materials, water, diamond and graphite. The cardboard paper was used to draw the mammalian blood and molecular structure of items listed above. This exercise took the researcher and the Biology teachers five day to organize.

(ii) ***Experimental group 2 (standard group):*** This group was taught the two concepts using imported mammalian heart and graphics available in the biology laboratory.

(iii) ***Control group:*** This group was taught the concepts using chalk-and talk method of teaching.

Results
Biology Performance Test (BPT) was used as a pre-test for determining the academic levels of both experimental and control groups. Pre-test data for the groups were analyzed using One-way Analysis of Variance. The results of the analysis are presented in Table 1.

Table 1: ANOVA results of experimental and control groups

Sources of Variation	Sum of Square	df	Mean Square	F-value	p-value
Between groups	5.911	2	2.956		
				0.401^{ns}	0.672
Within Group	309.733	42	7.375		
Total	315.644	44			

ns = not significant P>0.05

Table 1 shows one-way ANOVA results of students taught biology using Biology Performance Test in Biology (BPT). From the table 1, the results revealed that there was no significant difference in the mean achievement scores of students in the three groups (F_{value} = 0.401; p = 0.672). This indicates that there is no significant difference in the performance of experimental groups and the control group before the experiment started.

Hypothesis One: There is no significant difference in the performances of students exposed to standard instructional materials, improvised instructional materials and those taught with traditional method.
To test this hypothesis, one-way ANOVA was employed as shown in Table 2A.

Table 2: ANOVA results of experimental groups and control group

Sources of Variation	Sum of Square	df	Mean Square	F-Calculated	p-Value
Between groups	2526.711	2	1263.356		
Within Group	826.933	42	19.689	64.166*	0.000
Total	3353.644	44			

*Significant at P< 0.05

Table 2 shows ANOVA results of the mean performance scores of students in the experimental and control groups. The results revealed that there was significant difference in the mean performance scores of students in the three groups ($F_{cal} = 64.166$, p = 0.000). On this basis, hypothesis one is rejected. Therefore, there is significant difference in the performance scores of students exposed biology using standard, improvised and non-improvised instructional materials. In other to ascertain the location of the significant difference between the three groups, Scheffe's Post-hoc test was conducted on the data. The result is shown in Table 3.

Table 3: Scheffe's post-hoc analysis of the groups means scores

Groups	Mean Scores	Group I (Standard)	Group II (Improvised)	Group III (Control Group)
Group I (Standard)	72.60		*0.000	*0.000
Group II (Improvised)	64.20	*0.000		*0.000
Group III (Control Group)	54.26	*0.000	*0.000	

* The mean difference is significant at the 0.05 level.

The results in Table 3 indicates that there is significant difference in the posttest mean scores of students exposed to standard instructional material (X = 72.60) and those exposed to improvised instructional material (X = 64.20) in favour of experimental group I (standard). It also indicates that significant difference exists in the posttest scores of students exposed to improvised instructional material (X = 64.20) and those exposed to non-improvised instructional material (control Group) (54.26) in favour of experiment group II (improvised instructional material). Significant difference was also established in the posttest scores of students exposed to standard instructional material (X = 72.60) and those exposed to non-improvised instructional material (X = 54.26) in favour of standard instructional materials.

Hypothesis Two: There is no significant difference between the male and female students exposed to standard instructional material.
To test this hypothesis, t-test statistic was employed and the result is presented in table 3.

Table 3: t-test results on gender (experimental group I)

Variable	Number of sample	df	Mean (X)	SD	t – value	p-value
Male	7		72.86	4.87		
		13			0.227^{ns}	0.824
Female	8		72.38	3.29		

ns = not significant P>0.05

Table 3 revealed that the mean achievement scores for male students and female students taught with standard instructional material (Group I) and improvised instructional material are 72.86 and 72.38 respectively. The mean achievement scores for male did not differ significantly from that of their female counterparts when both groups were taught biology with standard instructional material (t_{value} = 0.227, df = 13, p = 0.824). On this basis, hypothesis 2 is not rejected. Therefore, there was no significant difference between the mean performance scores of male and female students taught biology with standard instructional material.

Hypothesis Two: There is no significant difference between the male and female students exposed to improvised instructional material.
To test this hypothesis, t-test statistic was employed and the result is presented in table 3.

Table 3: t-test results on gender (experimental group I)

Variable	Number of sample	df	Mean (X)	SD	t – value	p-value
Male	8		64.00	6.85		
		13			0.145^{ns}	0.887
Female	7		64.43	3.99		

ns = not significant P>0.05

Table 3 revealed that the mean achievement scores for male students and female students taught biology with improvised instructional material (Group II) are 64.00 and 64.43 respectively. The mean performance scores for male did not differ significantly from that of the female counterparts when both groups were taught biology with improvised instructional materials (t_{value} = 0.145, df = 13, p = 0.887). On this basis, hypothesis 3 is not rejected. Therefore, there is no significant difference between the mean performance scores of male and female students taught biology with improvised instructional material.

Discussion of Findings
The results of hypothesis one reveals that there is significant difference in the performance of students taught biology with standard, improvise instructional materials and those taught with traditional method in favour of the group taught with standard instructional materials. This result agrees with the findings of Gambari, Yaki & Olowe (2013), Ibrahim (2008) and Nsofor (2006) which confirmed that instructional materials has been effective in enhancing students' performance than conventional classroom instruction in biology. The higher achievement by the experimental group could be attributed to the advantages of using instructional materials which is not present in traditional teaching method. Instructional materials whether standard or improvised was found to captivate the attention of the students.
The results of hypothesis two and three show that there is no gender effect on the performance of male and female students taught biology concepts with standard instructional materials and improvised instructional materials. This finding is in agreement with the results of Tolu (2009) and Umar (2011), which revealed that there is no significant difference in the performance of male and female students in biology. Therefore, gender has no effect on students' academic performance when taught with standard and improvised instructional materials. However, it contradicts the finding of Kuta (2010) which revealed that male students performed better than female students when taught biology with community resources.

Conclusion
The paper has critically examined the importance of instructional materials in teaching biological concepts and its problems especially within the secondary school level in a rapidly changing world. It is the view of the authors that there is still a wide gap to be bridged in the area of teaching and learning. The use of standard and improvised instructional materials seems to be the answer. A standard instructional material was more effective in teaching the biological concept and is also gender friendly.

Recommendations
As a result of the fore going discussions and conclusion, the following recommendations were made as regards to improve the quality use of both standard instructional materials and the improvised instructional materials in the teaching of Biology in Secondary Schools:-
(i)   Teachers should be encouraged to use instructional materials to teaching abstract concepts to improve students' performance.
(ii)   Teachers should be encouraged to be more resourceful in materials selection and planning. This will reduce the cost of procuring the standard instruction. This could   be achieved by organizing seminars, workshop and in-service training for them.

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