COMPARATIVE EFFECT OF IMPROVISED AND STANDARD INSTRUCTIONAL MATERIALS ON SECONDARY SCHOOL STUDENT'S ACADEMIC PERFORMANCE IN SENIOR SECONDARY PHYSICS IN UYO, AKWA IBOM STATE

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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 physics in the Uyo local government area of Akwa Ibom State, Nigeria. Forty-five (24 male and 21 female) SS1 students from three secondary schools in Uyo, Akwa Ibom State, made up the sample. Standard instructional materials (SIM) and improvised instructional materials (IIM) for teaching physics concepts were determined using Pretest – Posttest experimental group design. The reliability coefficient of the Biology Performance Test was 0.84 using the Kuder-Richardson (KR-21) formula. The schools were randomly assigned to two experimental groups and a control group. The experimental groups were taught selected concepts of physics using SIM and IIM, while traditional methods were used for the control group. Results revealed that the students taught with SIM performed better than the IIM and control groups, respectively. The SIM and IIM were found to be gender friendly as well. Based on the findings, it was recommended that teachers should be encouraged to use instructional materials to teach abstract concepts to improve students' performance.

KEYWORDS: **Improvised Instructional Materials, Standard Instructional Materials, Physics, gender and academic performance.**

Introduction

The advent of science and technology, for example, has made life significantly easier for men. Science has made a significant contribution to the development of the modern world. Man has improved his understanding of his environment through science and technology, which has allowed him to control environmental circumstances for his own gain. The easy acquisition of man's desired requirements has also been made attainable through the application of science. Human needs have been scaled back to their absolute minimum. According to Ogunleye (2008), science is a dynamic human endeavor that aims to comprehend how the world functions. Man is able to learn more about the universe thanks to this understanding. Without the use of science, it would not have been feasible for humans to investigate the other planets in the cosmos, nor would they have been aware of their existence. The physics curriculum puts a premium on problem-solving, critical thinking, the development of experimental and computational skills, and the improvement of written and oral communication skills. Students are exposed to a variety of teaching and learning techniques in physics. Depending on the subject one wishes to teach, these include demonstration, lecture, discussion, discovery, laboratory, and activity-based learning. (FME, 2013). The study of matter, energy, and their interactions is known as physics. Physics poses fundamental issues and seeks solutions through observation and experimentation. The most basic and all-encompassing law or principle that can be used to describe the interaction is what physicists try to do. The goal of physics is to comprehend how nature functions by using scientific approaches and to comprehend the most fundamental concept of nature, the interaction of matter and energy. Physics is a discipline that involves problem solving, which calls for stronger deductive thinking, the ability to spot abstract patterns, and the ability to manipulate symbolic relationships. The objectives of physics, as identified by FME (1988), are to enable learners to

i. develop an interest in science and technology;

ii. acquire basic knowledge and skills in science and technology;

iii. Apply scientific and technological knowledge and skills to meet contemporary societal needs;

iv. Take advantage of the numerous career opportunities provided by science and technology;

v. Become prepared for the further studies in science and technology;

vi. Avoid drug abuse and related vices, and

vii. Be safety- and security-conscious.

The achievement of these goals is extremely important and calls for a teacher who employs learner-centered teaching strategies since learning occurs when students are actively involved in the teaching and learning process. Therefore, the teacher's challenge is to create meaningful teaching that will result in meaningful learning. (Novak, 2002). The instructor should consider the building of an educational facility when carrying out this duty of teaching in order to aid in the development of students' higher intellectual skills, which in turn serve as an anchor for the content to be learned. One of the most challenging yet fascinating courses in the school curriculum was physics. (Gambari, Yaki, & Olowe, 2013). According to the chief examiners' report from the West African Examination Council (WAEC), Nigerian students generally performed poorly in Physics at Ordinary Level. (WAEC, 2011, 2012, and 2013). Lack of teaching resources for biology at the senior secondary school level in Nigeria is one of the causes of subpar performance. Physics instruction should be based on the surroundings of the pupils, which necessitates the use of educational resources, which may be locally developed (improvised) or conventional educational resources. The act of improvising involves introducing unique ideas or making adjustments. When there are shortages or a lack of certain first-hand teaching materials, the process of using alternate materials or resources to facilitate instruction is used. According to James' definition from 2007, improvising is when a teacher creates equipment out of cheap, readily available local materials to replace unavailable, expensive conventional equipment (standard instructional materials).

Perhaps as old as experimental research itself is improvisation in science education. To assist needy schools in war-torn countries, improvise their equipment needs, a more systematic approach to improvisation in science was developed in response to the acute shortage of laboratory equipment following World War II (UNESCO source book title: "suggestions for science teachers in devastated countries"). It is necessary to use instructional materials and equipment in order to teach physics properly. Diverse models and pieces of equipment can be used to teach science subjects in an effective way. The materials are essential to the teaching of physics because they increase student engagement throughout the teaching and learning process, enable more students to be taught at once, encourage full class participation, and break up the monotony of instruction. In order to achieve the aforementioned benefits, physics is best taught in secondary schools with the use of teaching materials. (Gambari, Yaki, & Olowe, 2013). It is stated that, in the absence of standard instructional materials, the materials required must be enhanced because many of the materials required for teaching physics are abundant in the natural environment. Science educators have long been aware of the improvisation of science materials. (Akinsola, 2000).

Teachers frequently employ the outdated chalk-and-talk style of instruction in schools in Nigeria, which is ineffective for today's science teaching and learning. Learning through the senses of sight, smell, touch, and taste is made possible through the use of instructional materials. It has been discovered that not all children's sensory organs function at the same level. (Nwaorgu, 2007). In scientific classes, emphasis should be placed on using a variety of teaching tools that can engage as many senses as possible. The rate of assimilation by the pupils will be significantly increased when pertinent, industry-standard educational materials are employed in classroom activities. Gambari & Gana (2005) Studies have revealed that educational materials improve students' performance more than conventional methods of instruction. (Gambari, Yaki, & Olowe, 2013; Ibrahim, 2008; Nsofor, 2006). Gender studies have had mixed results nonetheless. According to Tolu (2009) and Umar (2011), there was no discernible difference between male and female students' understanding of physics ideas, while Kuta (2010) found that male students did better than their female counterparts. It should be remembered that while instructional materials and aids cannot completely replace the teacher, they can be used to enhance learning and make lessons more relevant. More specifically, improvised instruction and standard instructional materials (SIM) could increase students' grasp of physics concepts. Because of this, this study looked at how standard and improvised instructional materials affected secondary school students' academic performance in physics in secondary schools in Akwa Ibom Uyo local government area.

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.

Research Methodology

The area of the study was the Uyo Local Government Area. It has been the Akwa Ibom state capital since 1987. It lies between latitudes 7°213 and 7°331 north and longitudes 8°480 and 9°841 east. It has a population of over 490,000 inhabitants (National Population Census, 2006). It is bounded in the north by Itu, on the south by Ibesikpo Asutan, on the west by Nsit Ibom/Etinan, and on the east by Uruan. The major indigenous language is Ibibio. The researcher chose the area for the study because she is quite familiar with educational problems in the area, and he is also an indigene of the area. The research design adopted for this study was a pretest-posttest experimental group design. Senior secondary class one (SS1) students from the sampled schools were assigned to the experimental conditions, namely, the 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 standard instructional materials, improvised instructional materials, and conventional methods of teaching. The dependent variable is the students' scores. All the secondary schools in Uyo, Akwa Ibom State, constitute the target population of the study. Three schools were randomly sampled from 14 secondary schools in Uyo, L.G.A. The sample consisted of forty-five students (24 males and 21 females) from SS1 class. The schools were randomly assigned to three groups (improvised, standard, and control). Each group consisted of fifteen students.

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The justification for the selection of SS1 students is based on the fact that the unit of physics (electricity energy) for instruction considered in this study was taught in SS1. The instrument employed in this study was a researcher-designed Physics Performance Test (PPT). The PPT consists of a 20-item, multiple-choice objective test with 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 selected for the purpose of this study. The PPT measured the performance of students at both pre-test and post-test. The PPT was validated by a three-person team of experts from the Science Education Department at the University of Uyo, and its reliability coefficient was determined to be 0.84 using Kuder Richardson (KR-21). The study lasted for three weeks. The objectives and the modalities of the experiments were specified, and an operational guide was produced before the commencement of the treatment. The physics taught used the following procedures:

(i) **Experimental groups 1 (improvised group):** This group were taught the concepts using improvised instructional materials.

(ii) **Experimental group 2 (standard group):** This group was taught the concepts using available laboratory facilities.

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

Results

Physics Performance Test (PPT) 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		
Within Group	309.733	42	7.375	0.401^{ns}	0.672
Total	315.644	44			

ns = not significant P>0.05

Table 1 shows the one-way ANOVA results of students taught physics using the Physics Performance Test in Physics (PPT). From 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 was no significant difference in the performance of the 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-value	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 the ANOVA results of the mean performance scores of students in the experimental and control groups. The results revealed that there was a significant difference in the mean performance scores of students in the three groups (Fcal = 64.166, p = 0.000). On this basis, hypothesis one is rejected. Therefore, there is a significant difference in the performance scores of students exposed to physics instruction using standard, improvised, and non-improvised instructional materials. In order 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 indicate that there is a 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 a 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). A 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 Samples	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 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 males did not differ significantly from that of their female counterparts when both groups were taught physics 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 Physics 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 Samples	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 and female students taught Physics with improvised instructional material (Group II) are 64.00 and 64.43, respectively. The mean performance scores for males did not differ significantly from that of their female counterparts when both groups were taught physics 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 Physics with improvised instructional material.

Discussion of Findings

The results of hypothesis one reveal that there is a significant difference in the performance of students taught physics with standard, improvised instructional materials and those taught with traditional methods, with the results favoring the group taught with standard instructional materials. This result agrees with the findings of Gambari, Yaki, and Olowe (2013), Ibrahim (2008), and Nsofor (2006), which confirmed that instructional materials have been more 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 are not present in traditional teaching methods. Instructional materials, whether standard or improvised, were found to capture the attention of the students.

The results of hypotheses 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 at 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 was also gender friendly.

Recommendations

1. Teachers should be encouraged to use instructional materials to teach abstract concepts to improve students' performance.

2 Teachers should be encouraged to be more resourceful in material selection and planning. This will reduce the cost of procuring the standard instructions. This could be achieved by organizing seminars, workshops, and in-service training for them.

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