Instructional Materials and Students’ Academic Achievement in Physics: Some Policy Implications

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Abstract

The study examined the effect of using standardized and improvised instructional materials on Academic Achievement of Secondary School Physics Students in Oyo State, Nigeria. The research design adopted was quasi-experimental of the pretest – post test non-randomized control group. Purposive sampling was used to obtain a sample of three co-educational secondary schools. Each school provided one S.S. III class for the study. Two instruments were used in the study, the Physics Achievement Test (PAT) to measure students’ achievement and Teachers Instructional Guide (TIG) to train the teachers in the experimental groups. The instrument was pilot tested to ascertain reliability. The reliability coefficient was 0.76. Three hypotheses were formulated and tested at 0.05 level of significance. Data were analysed using ANOVA and ANCOVA. Findings revealed that there is a significant difference in the achievement of students taught using standard instructional materials, those taught with improvised instructional material and those in the conventional instruction. Thus, the students taught with improvised instructional materials obtained the highest achievement score at post test (F=74.94), followed by those with standard instructional materials (F=63.07), while the control group scored the lowest (F=39.89). Also, there was no significant effect of gender on students’ achievement in Physics although, females did better than males. Finally, there was no significant interaction effect of treatment and gender on student achievement in Physics. Thus, Physics teachers need to be resourceful in instructional materials selection, planning and utilization so as to reduce the cost of production and maintenance of instructional materials. The researchers conclude that the utilization of improvised instructional materials promote and enhance effective teaching-learning process, thus, Physics teachers should be encouraged to use them in secondary education programme.

Key words: Physics, Improvised instructional materials, Standardized instructional materials, Academic achievement
1.0 Introduction

1.1 Background to the Problem

Science has been regarded as the bedrock of modern day technological breakthrough is built. Nowadays, countries all over the world, especially the developing ones like Nigeria, are striving hard to develop technologically and scientifically, since the world is turning Scientific and all proper functioning of lives depend greatly on Science. According to Ogunleye (2002), Science is a dynamic human activity concerned with understanding the workings of our world. This understanding helps man to know more about the universe. Without the applications of science, it would have been difficult for man to explore the other planets of the universe.

Science comprises the basic disciplines such a Physics, Chemistry, Mathematics and Biology. Many investigations have shown that secondary school students are exhibiting dwindling interest in Science (Esiobu, 2005). Besides, Physics as one of the Science subjects remains one of the most difficult subjects in the school curriculum according to the Nigeria Educational Research and Development Council (NERDC) (Isola, 2010). Studies have revealed that the performance of Nigerian students in Ordinary Level Physics was generally and consistently poor over the years (Akanbi, 1983; Omosewo, 1999).

Poor academic achievement in Physics could be attributed to many factors among which teacher’s strategy itself was considered as an important factor. This imply that the mastery of Physics concepts might not be fully achieved without the use of instructional materials. The teaching of Physics without instructional materials may certainly result in poor academic achievement. Franzer, Okebukola and Jegede (1992) stressed that a professionally qualified science teacher no matter how well trained, would unable to put his ideas into practice if the school setting lacks the equipment and materials necessary for him or her to translate his competence into reality.

Bassey (2002) opined that Science is resource intensive, and in a period of economic recession, it may be very difficult to find some of the electronic gadgets and equipment for the teaching of Physics in schools adequately. A situation that is further compounded by the galloping inflation in the country and many at times, some of the
imported sophisticated materials and equipment are found expensive and irrelevant; hence the need to produce materials locally.

Researchers such as Obioha (2006) and Ogunleye (2002) reported that there were inadequate resources for teaching Science subjects in secondary schools in Nigeria. They further stated that the available ones are not usually in good conditions. There is the need therefore, for improvisation. Adebimpe (1997) and Daramola, (2008) however noted that improvisation demands adventure, creativity, curiosity and perseverance on the part of the teacher, such skills are only realizable through well-planned training programme on improvisation.

1.2 Statement of the Problem

In spite of the desire for technological development, couple with the fact that Physics is a very vital subject for technological development and as such, its teaching and learning as well as students’ poor academic performance have become a source of concerns to all stakeholders. The problem of the present study is to investigate the effects of using improvised instructional materials on the achievement of secondary school students in Physics.

2.0 Literature Review

The review of relevant literature to the present study was carried out in turn as indicated below. This is to further lay a solid foundation for the study.

2.1 Meaning of Instructional Materials

Instructional materials have been defined by various authors. For example, Obanya (1989) viewed them as didactic materials thing which are supposed to make learning and teaching possible. According to Abdullahi (1982), instructional materials are materials or tools locally made or imported that could made tremendous enhancement of lesson impact if intelligently used. Ikerionwu (Isola, 2010) referred to them as objects or devices, which help the teacher to make a lesson much clearer to the learner. Instructional materials are also described as concrete or physical objects which provide sound, visual or both to the sense organs during teaching (Agina-obu, 2005).
Instructional materials are in various classes, such as audio or aural, visual or audio-visual. Thus, audio instructional materials refer to those devices that make use of the sense of hearing only, like radio, audio tape recording, and television. Visual instructional materials on the other hand, are those devices that appeal to the sense of sight only such as the chalkboard, chart, slide, and filmstrip. An audio-visual instructional material however, is a combination of devices which appeal to the sense of both hearing and seeing such as television, motion picture and the computer. Among the instructional materials the classroom teacher uses, the visuals out-numbered the combination of the audio and audio-visual.

### 2.2 Instructional Materials and Academic Achievement

There have been several studies on instructional materials and academic achievement. For instance, Momoh (Isola, 2010), conducted a research on the effects of instructional resources on students’ performance in West Africa School Certificate Examinations (WASCE) in Kwara State. He correlated material resources with academic achievements of students in ten subjects. Data were collected from the subject teachers in relation to the resources employed in the teaching. The achievements of students in WASCE for the past five years were related to the resources available for teaching each of the subjects. He concluded that material resources have a significant effect on student’s achievement in each of the subjects.

In the same manner, Moronfola (1982) carried out a research in Ilorin Local Government Area of Kwara State. She used questionnaires to collect data on the material resources available for the teaching of some selected subjects in ten secondary schools and related these to students’ achievements in each of the selected subjects and to the amount of resources available for the teaching of the subjects. Finding showed a significant effect of material resources on the students’ academic performance in these subjects.

In the same vein, Popoola (1990) investigated the effect of instructional resources on the academic achievements of students in Ogun State. Five secondary schools in Abeokuta were used for this study. Questionnaires were designed to elicit
responses on instructional materials that were available for the teaching and learning of each of the three school subjects he examined. He collected WASC examination results for five years and compared achievements of students in schools with adequate material resources and achievements of students in schools with inadequate material resources. He found a significant difference in the achievements of the two sets of students. The schools with adequate instructional materials performed better than those with inadequate instructional materials.

2.3 Factors Affecting Improvisation of Instructional Materials

Balogun (2002) identified two main constraints militating against the successful improvisation of Science equipment. These are the technical and the human factors respectively. While the technical factors relate to the question of degree of accuracy and precision that is possible with the improvised equipment, the human factor relates to the teachers’ skill in developing the resources while providing the appropriate learning experience to the learners.

Also, Maduabunmi (2003) reported lack of adequate professional training as a major problem militating against the effective use of local resources for Science teaching. Oyediran (Isola, 2010) then stressed the need for a definite well planned training programme of improvisation for teachers. He suggested regular meaningful workshop on improvisation technique for Science teachers to improve and up-to-date their competence.

3.0 Method

3.1 Design.

The research design adopted for the study was quasi-experimental. The pre-test and post-test non-randomized control group design was carried out in selected secondary schools in Ibadan North-East of Oyo State.

3.2 Sample and Sampling Technique

The sample consisted of 60 senior secondary school Physics students that were selected through simple random sampling technique. The sample was divided into the
three groups namely the Improvised, the Standard and the Control). Each group was made up of 10 students.

3.3 Instruments

The instruments used in this study were a self-designed Physics Achievement Test (PAT). The Physics Achievement Test (PAT) contains 30 items 5 option multiple choice objective test. The students were made to select the correct answer from five options. PAT was used to measure the achievement of students in both pre-test and post-test. Some intervening variables extraneous to the study such as teacher effect, group interaction effect were controlled by the presence of one of the researchers and the Physics teachers in the schools used for the study.

Out of 30 items on the questionnaire, 14 were drawn from equilibrium of force and centre of gravity, 8 from comparison of e.m.f and application (uses of potentiometer), another 8 came from waves (microscope) application of light.

3.4 Hypotheses

The under listed hypotheses were formulated to guide the study. They were tested at 0.05 level of significance.

Ho1: There is no significant difference between students taught with standard instructional material, improvised instructional material and conventional instruction.

Ho2: There is no significant difference between male and female achievement score in the experimental and control group.

Ho3: There is no significant interaction effect of treatment and gender on student achievement in Physics.

3.5 Method of Data Analysis

The mean, standard deviation and the t-test statistical analysis were used. Scores of the different groups were computed and used in testing the hypotheses. The level of the significance that was adopted for the analysis is P = 0.05. This level of significance formed the basis for rejecting or not rejecting each of the hypotheses.
4.0 Results & Discussion
4.1 Test of Hypotheses

In testing the academic achievement of experimental and control groups on the pretest, a pre-test was administered to both the experimental and control groups. The test was the 30 items multiple-choice Physics Achievement Test (PAT). The students were allowed forty minutes to do the test. The test was given to determine the academic achievement of the experimental and control groups.

**Ho1:** There is no significant difference between student taught with standard instructional material, improvised instructional material and conventional instruction.

**Finding:** From Table 1, the main effect of treatment (types of instructional material) on students’ achievement in Physics is significant (F=115.969; P<.05). This means that there is a significant difference in the achievement of students taught using standard instructional materials, those taught with improvised instructional material and those in the conventional instruction.

To find out which of the two treatment groups and the control group performed better than the others, the Multiple Classification Achievement table is presented in Table 2. From Table 2, the students taught with improvised instructional materials obtained the highest achievement score at post test (F=74.94). Followed by those with standard instructional materials (F=63.07) while the control group scored the lowest (F=39.89). This shows that the improvised instructional material was the most effective, then the standard and then the conventional group.

Further, the Duncan post hoc analysis was used to trace the source(s) of the significant main effect of treatment on students’ achievement in Physics. Table 3 shows that each of the three possible pairs viz: standard (F=63.07) versus improvised (F=74.94) are significantly different; standard versus control (F=39.89) are significantly different; improvised versus control are also significantly different. Hence, all the pairs compared contributed to the significance obtained for treatment on achievement in Physics.
**Ho2:** There is no significant difference between male and female achievement score in the experimental and control group.

**Finding:** Table 4 showed that gender has no significant effect on students achievement in Physics (F=.065, p>.05). Hence hypothesis 2 is not rejected. This implies that the difference between the achievement of male and female is not significant. However, the MCA in Table 4 shows the gender group which performed better than the other. It was revealed that females performed better (F=59.52) than the male counterparts (F=59.04). This difference is not significant as shown earlier.

**Ho3:** There is no significant interaction effect of treatment and gender on student achievement in Physics.

**Finding:** Table 3 showed that the 2-way interaction of treatment and gender is not significant (F=1.927; P>.05). Hence, hypothesis 3 is not rejected.

### 4.2 Discussion

Findings from the present study revealed that there was significant effect of treatment on students achievement in Physics. The researchers found out that the students who were taught with the improvised instructional material achieved statistically significantly higher scores in the PAT compared to those who were taught with standard instructional material and conventional method. It is therefore observed that using improvised instructional materials assists the teacher economically and also allows students’ interaction which make students to achieve better in their lesson. It makes students use their intellectual ability during learning and teaching processes.

Improvised instructional material encourage creativity, bringing learning home wards and often better suited to the climatic conditions of the local environment which improve and enhance students achievement. This finding corroborates previous finding like that of Olosunde, (Isola, 2010). The reason for this might be due to the efficiency of the Physics teachers used for the study in handling the improvised instructional materials, and the locally improvised materials were easily understood by the students. This finding however contradicts those of...
Bassey (2002), who reported that students taught with the standardized instructional materials had the highest achievement.

It was also found that there was no significant effects of gender on students achievement in Physics. This implies that both male and female students achieved equal under the same condition during learning and teaching process, since achievement has to do with mental and intellectual ability and not gender. This result agreed to the view of Moronfola (2002) who stressed that Science subjects should be taught primarily as a practical subject. Omosewo (2008) ascertained that in a modern Science curriculum programme, students (male and female) need to be encouraged to learn not only through their eyes or ears but should be able to use their hands and head to manipulate apparatus.

Okoboli (Isola, 2010) study on gender difference in academic achievement of primary school pupils in English language and Mathematics in relation to the results obtained above observed significantly difference among female and male students in the two subjects and the difference was in favour of using instructional materials. Finally, there was no significant interaction effect of treatment and gender on student achievement in Physics.

5.0 Conclusion, Implications and Recommendations

5.1 Conclusion

The place of instructional materials in the effective implementation of any education programme cannot be under-mined. 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.

Instructional materials supplement, clarify, vitalize, emphasize instruction and enhance learning in the process of transmitting knowledge, ideas, skills and attitude. This calls for teacher’s resourcefulness and improvisation on the parts of the Physics teachers. The ability of the teacher to make us of “local” materials in place of “standard” ready-made materials makes lesson more effective and improved students’ achievement.
5.2 Some Policy Implications

Findings from the present study have some implications for the educational policy makers. These include:

- There should be policy formulation that will ensure adequate provision for instructional materials, both foreign and local.
- All Science subjects teachers should be exposed to, and trained on the art of improvisation of instructional materials on regular basis so as to make teaching-learning more effective.

5.3 Recommendations

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

- There is the need for teachers to be resourceful in instructional materials selection 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.
- There is also need for the development of positive attitudes by teachers towards the use of instructional materials for their students. This will encourage the development of their proficiency.
- The cost of procuring instructional materials should not be too high so that many stakeholders will be able to afford.
- Regular supply of instructional materials should be embarked on by the Governments at all levels.
References


### Table 1: Assignment of Samples into Treatments Groups

<table>
<thead>
<tr>
<th>Group</th>
<th>Pre-test</th>
<th>Treatment</th>
<th>Post-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental group (1)</td>
<td>01</td>
<td>X₁</td>
<td>04</td>
</tr>
<tr>
<td>Control group</td>
<td>02</td>
<td></td>
<td>05</td>
</tr>
<tr>
<td>Experimental group (2)</td>
<td>03</td>
<td>X₂</td>
<td>06</td>
</tr>
</tbody>
</table>

### Table 2: Summary of ANCOVA of Post Test Achievement by Treatment and Gender

<table>
<thead>
<tr>
<th>Source of Variance</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Covariates PRE</td>
<td>163.013</td>
<td>1</td>
<td>163.013</td>
<td>3.298</td>
<td>.075</td>
</tr>
<tr>
<td>Main Effects (Combined)</td>
<td>11465.799</td>
<td>3</td>
<td>3821.933</td>
<td>77.334</td>
<td>.000</td>
</tr>
<tr>
<td>TREATMENT</td>
<td>11462.611</td>
<td>2</td>
<td>5731.306</td>
<td>115.969</td>
<td>.000</td>
</tr>
<tr>
<td>SEX</td>
<td>3.188</td>
<td>1</td>
<td>3.188</td>
<td>.065</td>
<td>.800</td>
</tr>
<tr>
<td>2-way Interactions TREATMENT</td>
<td>190.466</td>
<td>2</td>
<td>95.233</td>
<td>1.927</td>
<td></td>
</tr>
<tr>
<td>SEX</td>
<td>11819.277</td>
<td>6</td>
<td>1969.880</td>
<td>39.859</td>
<td>.000</td>
</tr>
<tr>
<td>Residual</td>
<td>2619.323</td>
<td>53</td>
<td>49.421</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>14438.600</td>
<td>59</td>
<td>244.722</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant at P<.05*
Table 3: Multiple Classification of Post Test Achievement by Treatment and Gender.

<table>
<thead>
<tr>
<th>Treatment + Category</th>
<th>N</th>
<th>Predicted Mean</th>
<th>Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Un adjusted</td>
<td>Adjusted for Factors and Covariates</td>
</tr>
<tr>
<td>TREATMENT standard</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>improvised</td>
<td>20</td>
<td>61.9000</td>
<td>63.0683</td>
</tr>
<tr>
<td>control</td>
<td>20</td>
<td>74.6000</td>
<td>74.9374</td>
</tr>
<tr>
<td>SEX</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>27</td>
<td>61.1852</td>
<td>59.0367</td>
</tr>
<tr>
<td>female</td>
<td>33</td>
<td>57.7576</td>
<td>59.5154</td>
</tr>
</tbody>
</table>

R = .897
R Squared = .805

Table 4: Duncan Post HOC Analysis of Achievement by Treatment

<table>
<thead>
<tr>
<th>Treatment</th>
<th>N</th>
<th>F</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>1. Standard</td>
</tr>
<tr>
<td>1. Standard</td>
<td>20</td>
<td>63.07</td>
<td>*</td>
</tr>
<tr>
<td>2. Improvised</td>
<td>20</td>
<td>74.94</td>
<td>*</td>
</tr>
<tr>
<td>3. Control</td>
<td>20</td>
<td>39.89</td>
<td>*</td>
</tr>
</tbody>
</table>

*Pairs Significantly Different at P<.05