# Effect of Free Open Source Software Based Learning Package on Academic Achievement of Junior School Students in Basic Technology in Nigeria

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*Abstract*

*This study reported the use of a Free Open Source Software (FOSS) based learning package in teaching basic technology among Junior Secondary Schools students in Nigeria. This study adopted a quasi-experimental design, Specifically, the pre-test, post-test, non-equivalent control group design. 118 students of basic technology II (JSS2) were selected through multi stage sampling from four junior secondary schools in the country. Two of the schools with 60 students were used as control group while the remaining two schools with 58 students were used as experimental group. A validated Energy-Based Technological Appliances Achievement Test (ETAAT) was used for data collection. A reliability coefficient of 0.82 was obtained using test-retest reliability technique and Pearson Product Moment Correlation. Three research questions guided the study and three hypotheses were tested; Data collected were analysed using mean for the research questions and Analysis of covariance (ANCOVA) for the hypotheses at 0.05 level of significance. The research findings revealed that the experimental group taught basic technology with a FOSS based learning package had a higher academic achievement than those taught with the traditional lecture method. Also, with calculated F-value of 526.627 and probability value (significance of F) of .000, a statistically significant difference was revealed between the two modes of instructions. No significant difference was found between male and female students achievement on the effect of FOSS learning package in enhancing achievement in basic technology with calculated F-value of 4.659 and significance of F at .330. Based on the findings, it was recommended amongst other things that the use of Free Open Source Software based learning package should be adopted by teachers and school administrators to facilitate meaningful learning in basic technology. Also, computer assisted materials or packages be developed for topics that may need some extra support to teach.*

*Keywords: Basic Technology, Free Open Source Software, Traditional Teaching Approach, Academic Achievement*

## 1. Introduction

Basic technology is one of the integrated vocational subjects within the curriculum objectives of junior secondary school in Nigeria. It is a subject designed to introduce junior secondary school students to the world of technology and engineering with curriculum objectives which foster pre-vocational orientation in technology, basic technological literacy, creativity and serve as a foundation on which the march towards the economic survival of an individual and nation can be built. This basic technology is one of the subjects that laid the foundation for vocational programmes that teaches how human beings can be useful and contribute positively to the society.

A number of instructional methods have been used since different subjects including basic technology have been introduced to schools and various other methods are now emanating to improve how students learn, improved student academic achievements and productivity. The problem of teaching methodology employed in teaching technology related subjects have for sometime occupied the mind of researchers in the field of education who work to enhance learning and reduce failure rate in learning. Methods used in teaching students at various levels of education include lecture method, question and answer, project, textbook teaching, discussion, tutorial, audio-tutorial, demonstration, and problem solving methods. The prevalent method of basic technology instruction has been described as mainly expository (i.e. lecture method) with little involvement of students in experimentation. Many problems have been identified with traditional lecture method. In traditional teaching, the teacher is the authority and the students are passive learners. This method is

characterized by a talking teacher standing in front of the students; the pupils are with exercise books and other writing materials, the use of chalk and blackboard for writing. It possesses characteristics that make it teacher-centered, teacher-active, learner-passive, and content-emphasized method. Oladipo, Olowoye and Adenaike (2010) are of the opinion that teachers who depend solely on the lecture method are inexperienced. They argued that the utilization of lecture method cannot be an efficient and effective means of producing high caliber manpower for an emerging economy. This is one of the reasons why the country's education system has not been productive over the years. Hence, there have been calls for approaches which would promote resource-based learning and improved academic achievement.

One of the objectives of educational programmes through teaching is to enhance students' academic excellence. Students had been reported in researches not to do well in basic technology especially in junior school certificate examination due to factors among which teaching methods is a major concern (Onuoha, 1994, Onabanjo, 1999, Okotete, 2010). Aremu (2001) however found that pupils of varying ability levels perform differently depending on the types of method and material used for instruction. The fact that many basic technology students perform poorly in the subject and do not want to choose it for specialization might suggest that the subject is not being successfully transmitted. The issue of poor academic achievement of students in basic technology has been blamed on teachers' inadequacies in the classroom presentation and method selection (Ogbuanya & Usoro, 2009). In basic technology, problems such as abstraction of concepts in teaching and difficulties in understanding such concepts, inability of learners to link lessons with daily activities, inability to reach the objectives in lessons involving abstract concepts, and inadequacy of traditional teaching method to bridge the gap between abstract and reality of science related contents leads to students poor achievement. This method of instruction should be replaced with learner-centered, learner-facilitated, learner-active and learning process emphasized methods of instruction because it could not generate enough creativity and problem solving abilities but possesses repetition of the teacher's knowledge and ability.     However, students' achievement could be improved through committed and sincere teaching with strategies that will facilitate critical thinking, better understanding, and internalization of content.

To remove challenges of traditional teaching method, Ahmet et al. (2008) suggested bringing in new technologies which play an important role in the development of the education process to safeguard students against the negative effect of the rote memory based learning. Serin (2011) also revealed that the students' achievements increase when Computer Based Instruction (CBI) technique is used for instructional delivery. In an attempt to improve the state of affair for advancement of teaching and improved academic achievement, National Board for Technical Educational (NBTE) in conjunction with the United National Educational Scientific and Cultural Organization in 2007 jointly reviewed syllabus for revitalization of technology in Nigeria with the inclusion of Information and Communication Technology (ICT) and Computer Assisted Instruction (CAI) for optimum instructional delivery. Computer based learning materials and educational software are becoming widely used in schools and colleges as part of school practice nowadays.

Free Open Source Software (FOSS) is a new dimension in the educational development of software for preparing computer based instructional packages. It is free software from Microsoft and it is a tool that enables the learning community to create high-quality, interactive, computer based courses. This software allows publishing of computer based instruction by completing the easy-to-use learning content development system (LCDS) forms that seamlessly generate highly customized content, interactive activities, quizzes, games, assessments, animations, demos, and other multimedia. The content can be supported with software simulations, interactive Flash content such as Drag and Drop, tile puzzle game, among others in the learning content. The FOSS is an electronic learning system designed to aid individuals in creating interactive courses with text, pictures, movies and audio files (Brinkmann, 2008).

One of the features that would make the use of this computer based package attractive to learners is that concepts can be visibly displayed to learners to make learning more meaningful unlike traditional lecture method with abstraction. The use of this technology in education could provide students with a more suitable environment to learn, serves to create interest and a learning centered-atmosphere, and helps increase the students' motivation and achievement. Obideyi (2012) asserted that the use of technology in this way plays an important role in the teaching and learning process especially in improving student academic achievement. FOSS as a Computer-based multimedia application, because of its flexible and varied presentation capabilities, could form an effective alternative to traditional teaching methods. This learning package could be used to concretize abstract concepts which are difficult for students to learn by means of simulation, animation among others.

Lavicza (2006) found that software packages can be used to encourage discovery and experimentation in classrooms and their visualization features can be effectively employed in teaching to generate conjectures. Some basic technology concepts are abstract in nature and needs certain features of technology to bring the lessons closely to the

learners; features that can propel this are present in FOSS. It is therefore preferred for this study. Use of this learning package forms a teaching method that teachers could use for teaching. If this method of teaching could besides its promising potential improve students' academic achievement, it may also deliver competent subject graduates and enhance productivity irrespective of gender. Young (2000), Wilkowska, and Ziefle (2010) reported significant gender differences in computer attitudes and performance of students in the use of technology for classroom activities while Okeke (1999) reported that sex was not a significant factor in the pupils understanding of concepts in science and technology class when technology is used.

## 2. Statement of the Problem

Basic technology is one of the prevocational subjects in the junior school curriculum but because of its nature being science related with abstract concepts and contents, it is often difficult for students to understand which often leads to poor academic achievement. Ahmet and Ahmet (2008) reported that students are mostly unsuccessful in science related subject because of the constant use of traditional lecture method. This method of teaching propels learning difficulties which makes it a problem for students to link concepts learned in the classroom to their daily activities, forces students to learn by rote memorization, difficulty in recalling learned contents which mostly leads to poor academic achievement in this subject. Apart from students difficulties in learning, this method often forfeits teachers achievement of aims and objectives of lessons involving abstract concepts. This has severally been reported to account for students poor achievement in basic technology in examinations within and outside the school.

Meanwhile, education software are developed to assist in aiding effective teaching and learning of concepts that are abstract. The use of FOSS based learning package in preparing basic technology concepts and contents for teaching junior school students could salvage the problem of learning difficulties and academic achievement among students. It is therefore imperative to conduct a research to investigate the effect of this instructional software package on academic achievement of students. Could the use of FOSS learning package have a distinctive effect on enhancing academic achievement of students in basic technology as used against traditional lecture method? This research therefore, investigated the effect of Free Open Source Software Based learning Package on academic achievement of junior secondary school students in basic technology in Ogun State.

### 2.1 Purpose of the Study

The main purpose of this study was to investigate the effect of FOSS based learning package on academic achievement of junior secondary school students in basic technology. The study also investigated the difference in the performance of male and female students exposed to FOSS learning package; and the interaction effect of ability level and gender on the mean achievement of students taught basic technology with FOSS learning package.

### 2.2 Research Questions

The following research questions guided the study:
1. Is there any difference in the mean achievement of students taught basic technology with FOSS learning package and those taught with traditional lecture method.
2. Is there any difference in the performance of male and female students exposed to FOSS learning package.
3. Is there any interaction effect of ability level and gender on the mean achievement of students taught basic technology with FOSS learning package.

### 2.3 Hypotheses

The following hypotheses were formulated to guide the study and were tested at 0.05 level of significance:
1. There is no significant difference in the mean achievement of students taught basic technology with FOSS learning package and those taught with traditional lecture method.
2. There is no significant difference in the performance of male and female students exposed to FOSS learning package.
3. There is no significant interaction effect of ability level and gender on the mean achievement of students taught basic technology with FOSS learning package.

## 3. Methodology

This study adopted a quasi-experimental design. Specifically, the pre-test, post-test, non-equivalent control group design. This design was adopted because it was not possible for the researcher to randomly sample the subject and assign them to treatment and control groups without disrupting the academic programs of the schools involved in the study. The population for this study consisted of all basic technology II students in Nigeria. A multi stage sampling technique was used to select 118 basic technology II (JSS 2) students which comprised of 55 males and 63 females from 4 junior secondary schools which possessed the required information and communication technologies required for this study from Lagos and Ogun States in the country. Two out of the 4 selected schools were systematically assigned to experimental and the remaining two to control groups. Random sampling was finally used to select one intact class from the JSS2 arms of each of the four schools. The instrument for data collection was the Energy-Based Technological Appliances Achievement Test (ETAAT) validated by three experts. It consisted of 20 multi-choice test items with four options. The items of the achievement test covers the selected units. In determining the stability of the test instrument using test-retest reliability technique and Pearson Product Moment Correlation, a reliability coefficient of 0.82 was obtained. Two instructional approaches were used for this study; the use of FOSS-based package, a computer based teaching strategy for teaching the experimental group while traditional lesson plan was used for teaching the control group. The pretest was administered on both the experimental and control groups in order to ascertain the homogeneity of the two groups. After the pre-test, two weeks intensive teaching was given to the two groups. After the completion of the Energy Based Technological Appliances lessons, basic technology teachers administered the posttest to the subjects in their respective schools. The scores obtained from the posttest exercise provided post treatment data for the study. The data collected from the administration of pretest and posttest were analysed using mean to answer the research questions and Analysis of Covariance (ANCOVA) for testing the hypotheses at 0.05 level of significance.

## 4. Results

### 4.1 Research Question 1

Is there any difference in the mean achievement of students taught basic technology with FOSS learning package and those taught with traditional lecture method?

**Table 1:** Mean Achievement Scores of Students taught Basic Technology with FOSS Learning Package and those taught with Traditional Lecture Method

| Group | N | Pre-test ($\overline{x}$) | Post-test ($\overline{x}$) | Mean Difference |
|---|---|---|---|---|
| Experimental | 58 | 28.10 | 72.41 | 44.31 |
| Control | 60 | 26.67 | 39.83 | 13.16 |

The data presented in table 1 shows that the control group taught basic technology with traditional lecture method had a mean score of 26.67 in the pretest and a mean score of 39.83 in the posttest. The posttest mean achievement difference in the control group is 13.16. The experimental group taught basic technology with a FOSS based learning package had a mean score of 28.10 in the pretest and a posttest mean of 72.41 with posttest mean gain of 44.31. With these results, the effect of FOSS learning package on students' achievement is higher than the effect of the traditional teaching method.

### 4.2 Research question 2

Is there any difference in the performance of male and female students exposed to FOSS learning package?

**Table 2:** Mean Achievement Scores of Male and Female Students taught Basic Technology with FOSS Learning Package

| Group | Gender | N | Pre-test | Post-test | Mean Difference | Difference |
|---|---|---|---|---|---|---|
| **Experimental** | Male | 28 | 29.46 | 74.82 | 45.36 | |
| | Female | 30 | 26.83 | 70.35 | 43.52 | **1.84** |
| **Control** | Male | 27 | 26.67 | 41.48 | 14.81 | |
| | Female | 33 | 26.67 | 38.49 | 11.82 | **2.99** |

Table 2 shows the mean pretest score of 29.46 for male subjects in the experimental group while the mean score for their female experimental group counterparts was 26.83. In the posttest, the mean achievement score of 74.82 for male subjects in the experimental group is higher than that of their female counterpart who had a mean score of 70.35. It can also be seen that the 45.36 mean gain of male subject in the experimental group is higher than the 43.52 mean gain of female subjects in the experimental group. The difference in the mean gain of male and female subjects in the experimental group is 1.84 in favour of the males.

### 4.3    Hypotheses 1

There is no significant difference in the mean achievement of students taught basic technology with FOSS learning package and those taught with traditional lecture method.

**Table 3:** Analysis of Covariance on Students Achievement in Basic Technology

| Source | Type III Sum of Squares | Df | Mean Square | F | Sig. of F (p) |
|---|---|---|---|---|---|
| Corrected Model | 33761.531[a] | 4 | 8440.383 | 147.838 | .000 |
| Intercept | 21418.975 | 1 | 21418.975 | 375.166 | .000 |
| PRETEST | 1574.365 | 1 | 1574.365 | 27.576 | .000 |
| GENDER | 265.966 | 1 | 265.966 | 4.659 | .330 |
| GROUP | 30066.169 | 1 | 30066.169 | 526.627 | .000 |
| ABILITY LEVEL * GENDER | 182.208 | 3 | 30.368 | .637 | .700 |
| Error | 6451.392 | 113 | 57.092 | | |
| Total | 409925.000 | 118 | | | |
| Corrected Total | 40212.924 | 117 | | | |

*Significant at Sig of F < .05

The data presented in table 5 shows that the F-value for the effect of FOSS based learning package on students academic achievement is 526.627 with a significance of F at .000, which is lower than the 0.05 level at which it is been tested. The null hypothesis is therefore rejected at 0.05 level of significance. With these result, there is a significant difference between the main effects of treatment on student achievement in basic technology.

### 4.4    Hypotheses 2:

There is no significant difference in the performance of male and female students exposed to FOSS based learning package.

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The result in table 3 show that the F-value for the effect of FOSS based learning package on students academic achievement based on gender is 4.659 with a significance of F at .330, which is greater than the 0.05 level at which it is been tested. The null hypothesis is therefore not rejected at 0.05 level of significance. With these result, there is no significant difference in the effects of FOSS based learning package on student achievement in basic technology based on gender.

### 4.5 Hypotheses 3:

There is no significant interaction effect of ability level and gender on the mean achievement of students taught basic technology with FOSS learning package.

The result in table 3 shows that the F-value for the interaction effect of students ability level and gender on their achievement in basic technology is .637 with a significance of F at .700 which is greater than the 0.05 level at which it is been tested. The null hypothesis is therefore not rejected at 0.05 level of significance. With these result, there is no significant

interaction effect of ability level and gender on the mean achievement of students taught basic technology with FOSS learning package.

## 5. Discussion and Conclusion of Findings

The findings in this study based on research questions raised and answered revealed that the main effect of FOSS based learning package on achievement of junior school students in basic technology is higher than the main effect of traditional method with a marginal mean scores of 31.15. Also, the effect of male students taught basic technology with FOSS based learning package was higher than the main effect of female with a mean difference of 1.84. In the same vein, analysis of covariance with calculated F-value of 526.627 and probability value (significance of F) of .000 revealed a statistical significance of the effect of FOSS based learning package for teaching basic technology on students' achievement. The result revealed no statistically significant difference between male and female students achievement on the effect of FOSS based learning package in enhancing achievement in basic technology with F-value of 4.659 and significance of F at .330; It also revealed no statistically significant interaction effect of ability level and gender on students achievement in basic technology with F-value of .637 and significance of F at .700.

From findings on the use of FOSS based learning package, it can be concluded that, the use of FOSS based learning package for instructional delivery is more effective than the traditional lecture method in enhancing students achievement in basic technology. These findings are supported by results of Lavicza (2006) and Obideyi (2012) that the use of technology in this way plays an important role in the teaching and learning process, most especially improving student academic achievement. The findings of Serin (2011) also revealed that the students' achievements increase when Computer Based Instruction (CBI) technique is used for instructional delivery.

Findings on the difference between male and female students achievement based on use of FOSS based learning package in enhancing achievement in basic technology revealed no significant difference. Therefore, it can be concluded that the use of FOSS based learning package in enhancing students achievement in basic technology is effective and beneficial to both male and female students. Contrary to the findings of this study, Young (2000), Wilkowska, and Ziefle (2010) found significant gender differences in computer attitudes and performance of students in the use of technology for classroom activities. In support of the findings of this study however, Okeke (1999) reported that sex was not a significant factor in the pupils understanding of concepts in science and technology class when technology is used.

Based on findings in this study, no interaction effect of students ability level and gender was found to have influenced students achievement with the use of FOSS learning package. This is contrary to the findings of Aremu (2001) who found that pupils of varying ability levels perform differently depending on the types of method and material used for instruction. Therefore, it can be concluded that in the use of technology such as FOSS based learning package in enhancing students achievement in basic technology, both ability level and gender differences are not mediating students understanding and achievement. This implies that students of varying ability level and both sex are beneficiaries when this type of technology is used for facilitating students learning. Based on the achievement of students with the use of FOSS in learning basic technology as found in this study, emphasis should be on teaching methods and strategies for improving students achievement rather than on gender and ability level of students. This is very important since all students both males and females are expected to benefit from any teaching method adopted by the teacher.

## 6. Recommendations

Based on the findings of this study, it was recommended that the use of Free Open Source Software based learning package should be adopted by teachers and school administrators to facilitate meaningful learning in basic technology. Also, computer assisted materials or packages should be developed for topics that may need some extra support to teach. It is needful to incorporate training on use of various educational software such as FOSS in the training of pre-service teachers which will impact them with the knowledge of using this instructional strategy. It is recommended that curriculum developers and planners should discourage use of instructional strategies which are found inadequate and encourage use of new strategies being recommended in studies like this which are found more adequate. In-service training, seminar, conferences and workshops should be organised by ministry of education and administrators for serving teachers in junior secondary schools to improve their knowledge and skill on the use of FOSS among other educational software which have been found very effective in promoting students achievement in basic technology among other subjects.

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