

# Effects of Experiential Teaching Method on Pupils' Achievement in Basic Science and Technology

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**Abstract** - This study explored the effects of experiential teaching method on pupils' academic achievement in basic Science and Technology. The study adopted a pretest, post-test, non equivalent control group design. Two research questions and two null hypotheses guided the study. A total of 426 pupils from 6 intact classes participated in the study. Three intact classes were assigned to treatment group, while the other three intact classes were assigned to control group. The treatment group was taught Basic Science and Technology (BST) using experiential teaching method, while the control group was taught the same topics using the conventional teaching method. A Basic Science and Technology Achievement Test (BSAT) was used for data collection. Research questions were answered using adjusted mean while the hypotheses were tested at 95% confidence level using the Analysis of Co-variance (ANCOVA). The results revealed that there was a significant difference between pupils taught basic science and technology using experiential teaching method and those taught BST using the conventional (traditional) teaching method. The experiential teaching method proved to be more facilitative. Finally, it was found that there was no interaction effect between method and gender on pupils' achievement in basic science and technology.

**Key Words** - Experiential teaching method, Basic science, Technology, Quasi-experiment

## Introduction

Knowledge in basic science is central and indispensable to the development of every nation. This is due to its crucial roles in the child's survival, adjustment and adaptation to his/her immediate and wider environments dominated by scientific activities. Any child that lacks the basic knowledge in science and technology can not participate meaningfully in some social activities. For a child to adapt, adjust and develop maximally in an environment he/she must be scientifically literate. In recognition of the indispensability of science in national development, the Federal Government of Nigeria (FGN) made the study of science and technology compulsory at all levels of basic education. Indeed, one of the objectives of basic education in Nigeria as stated in the national policy on education (NPE) is the laying of solid foundation for scientific and reflective thinking (FRN: 2004). To accomplish this objective, government further stated that there will be entrenchment of science teaching in the primary school curriculum (FRN 1986). Apart from ensuring the entrenchment of science and technological literacy in the Nigeria Populace government also intends to ensure that solid foundation for further studies of science at higher levels is laid at the basic education level.

But contrary to Government's intentions and policy objectives, records of research findings available in Nigeria indicate abysmal achievement in science and technology by pupils at the basic education level. This raises obvious doubts on the possibility of actualizing the Millennium Goals on science and technology education.

In a similar vein, Salami (Abonyi and Umeh, 2014) observed that the performance of secondary school

students in science and mathematics in particular is very discouraging. If secondary school students perform poorly in science and technology based subject, it is obvious that the right foundation was not laid at the basic education level. The weak foundation at the basic education level may have affected learners' attitude towards science subjects which culminates in poor performance at the senior secondary school level. Developing a solid foundation for further studies in science is one of the cardinal objectives of the basic science and technology curriculum. According to Universal Basic Education Commission (2009:409) children's weak background in science and technology is a source of great concern. This situation is unacceptable if Nigeria is to achieve the objectives of vision 20 2020.

This ugly situation could be attributed to several factors that range from the curriculum to pedagogy. Sometimes, teachers do not relate topics they teach in science to pupil's daily activities. In other cases pupils are denied the opportunity of participation in the teaching/ learning process. The UBEC survey of 2007 attributed the high failure rate in basic and technology to "teachers and their instructional strategies. Nworgu and Nwazojie (2003:120) had earlier observed that "the didactic method which teachers employed in teaching primary science emphasizes rote memorization and regurgitation of facts with pupil's activities being given less emphasis. Science unlike other subject cannot produce the desired results if taught through didactic method and mere regurgitation approaches. Through activity based approaches learners are guided to relate what they feel, observe and see in everyday life to the instructional procedure in the classroom. This is accomplished by making children carry

out some relevant activities in and outside the classroom as may be applicable. Ajiboye (2007:42) also noted that "lecture method is still popular in Nigeria, despite its obvious limitations. According to Ibe and Abonyi (2014) a serious aberration on the quality of science in Nigeria is due to the over-emphasis on mastery of subject content, theory and excessive examination consciousness against practical orientation towards science based disciplines. This according to them led to the failure of the science education program in the developing countries and Nigeria in particular. By the application of the didactic approach in teaching of science and technology, science is viewed as pieces of information and pupils do not see the big picture (Ling and Boo 2007).

For science instruction to be productive, teachers should note that science encompasses the first hand use of physical and mental skills to generate and test reliable knowledge and generalization.

In learning science, the process skills involve observing, measuring, classifying, inferring, predicting, hypothesizing, identifying variables, experimenting and interpreting data. Generally, these are processes carried out by scientists during investigations. The aim of this approach is for pupils to learn with understanding through development of their own ideas, which are taken seriously and not ignored in favour of the 'right answer'. Therefore the teaching method that should be adopted for teaching of science must be carefully considered and should encourage development of science process skill by the learners. The attention of many science educators has continued to be directed at searching for such appropriate methods of science teaching.

Many science education researchers have focused on teaching approaches such as, personalized system of instruction (PSI), concept mapping method, problem solving, and affective science teaching method, among others. It is, however, evident that those methods enumerated are activity-base, hands on and participatory approaches but they generally lack the full applications of experiential learning. The experiential teaching approach is based on the model designed by Kolb based on Dewey's theory of experience. The model builds on the concepts that children learn best by being interested fully in their own work, by interacting with one another, doing the tasks themselves, by puzzling themselves, by verifying their own suppositions, by experimenting, and by drawing conclusions based on the strength of evidence which they have collected (Ajiboye and Ajitoni 2008). It is also based on the fact that social interaction in a science class could foster positive attitude to science among pupils (Olaoye and Akinsola 2007). In the application of experiential teaching method, children, are shared into small groups in the classroom and are engaged in meaningful activities, with

the teacher moving round the groups to facilitate the pupils' interaction with the materials to enable them make meaning out of them so that meaningful learning can take place. Most importantly is that the learners' past experiences that are brought to bear in the application of the experiential teaching method. Experiential teaching method is a form of participatory learning. Participatory learning strategy has its theoretical basis in the behaviorists, the cognitivists, the constructivist and the social learning theorists (Ajiboye and Ajitoni 2008).

Experiential teaching model portrays four major stages involved in the learning. These consist of two related modes of grasping experiences (concrete experience and abstract conceptualization). It also consists of another two major model of transforming the experiences (reflective observation and active experimentation). These stages may or may not follow in sequence; it depends on the nature of learning that is to take place. The experiential teaching model makes room for transfer of learning to take place, which is what is seriously lacking in the current didactic (conventional) teaching approach used by teachers.

Although research evidence (Okoli and Abonyi, 2014) has revealed the efficacy of experiential learning in senior school biology evidence of its efficacy at the primary science level is still lacking. As such it is yet to gain wide acceptance as a teaching method in Nigeria, especially in the teaching of basic science and technology. It is therefore very indispensable to substantiate in quantifiable terms the exact effects of experiential teaching approach on the mean achievement scores of primary school pupils in basic science and technology.

### Objectives of the Study

The purpose of the study was to determine the effect of experiential teaching approach on pupils' achievement in basic science and technology.

Specifically this study ascertained the following:

- i. effects of experiential teaching approach on pupils achievement in basic science and technology
- ii. effects of experiential teaching approach on mean achievement scores of male and female pupils in basic science and technology
- iii. the interaction effect of teaching method and gender on pupils' achievement in basic science and technology.

### Scope of the Study

The study was conducted with basic school class six pupils. Basic school was chosen because it is considered foundational to other level of education. Secondly, emphasis is on basic six because it is a transition class that prepares pupils for the study of basic science in junior secondary school.

The study covered the following topic in basic science and technology:

- (i). You and environment
- (ii). Living and non-living things
- (iii). You and energy
- (iv). You and technology

### Research Questions

The following research questions guided the study:

1. What is the effect of experiential teaching method on the pupils' mean achievement scores in basic science and technology?
2. What is the effect of experiential teaching method on the mean achievement scores of male and female pupils' in basic science and technology?
3. What is the interaction effect of teaching methods and genders on pupils' mean achievement scores of pupils in basic science and technology?

### Hypotheses

The following null hypotheses were tested at 95% confidence level:

**HO<sub>1</sub>:** There is no significant difference in the mean achievement scores of pupils taught basic science using experiential teaching method and those taught using the conventional method.

**HO<sub>2</sub>:** There is no significant difference in the mean achievement score of male and female pupils taught basic science and technology using the experiential teaching method.

**HO<sub>3</sub>:** There will be no significant interaction between teaching method and gender on pupils mean achievements scores in basic science and technology

### Research Method

This study employed a quasi-experimental design. The specific design for the study is the pre-test, post-test, non-equivalent, control group design. Intact classes were used for the study. There was no randomization of subject as randomization would have disorganized the schools within the period of the study. The participants for this study were drawn from six primary schools in Ebonyi State of Nigeria. The schools were selected through simple random sampling. All the pupils in Basic Six (Sixth grade) in the sampled schools were used for the study. Three of the schools were assigned to the treatment group while the remaining three were assigned to control group. Assignment of schools to treatment or control group was achieved through simple balloting.

The instrument used for data collection is the Basic Science and Technology Achievement Test (BSTAT). The instrument was developed and validated by the researchers. It consists of 40 multiple choice items with four options and was drawn from the topics taught during the experiment. The instrument was subjected to face and content validation. A reliability co-efficient of 0.83 was obtained from the instrument using the Kuder-Richardson (K-R<sub>20</sub>) approach. It also has a stability index of 0.77 which was obtained from a test retest carried out within an interval of two weeks.

At the onset of the experiment the Basic Science and Technology Achievement Test (BSTAT) was administered to the research subjects in both the treatment and control groups as pretest. The treatment group was taught Basic Science and Technology using the experiential teaching package, while the control group was taught the same topics using the conventional teaching package. The study lasted for two months. At the end of the eight weeks, the research assistants administered the post test to both groups. They also marked the scripts and scored them and then handed them over to the researchers. Mean and standard deviation were used to answer the research questions while analysis of covariance (ANCOVA) was used to test the null hypotheses at  $\alpha$  level of 0.05.

### Control of Extraneous Variables

The following are extraneous variables that were controlled to ensure that their effects do not interfere with the internal validity of the study.

#### *Hawthorne Effects*

To ensure that the pupils are not aware that they are being used for experiment, the class teachers were used as the research assistants. Secondly, intact classes were used. There was no reshuffling or regrouping of subjects. The research assistants were duly informed of the dangers of informing the pupils that they are being used for experimental study.

#### *Testing effect*

To check the effect of testing, the items in the instrument (BSTAT) were rearranged after the initial pretest. The colour of the paper was also changed.

### Teacher variables

The teachers were trained on the use of the packages. The teachers in the two groups were clearly directed on when and how to administer the tests and treatments. The researcher also monitored them closely to ensure uniform approach.

### Initial Equivalence

Because intact classes were used for this study it is implied that the treatment and control groups are not of equal cognitive strength at the onset of the experiment. Adjusted mean and the Analysis of Co-Variance were used for data analysis.

**Table 1:** Adjusted mean and standard deviation of achievement scores of pupils taught Basic Science and technology using the experiential teaching approach and those taught with the Conventional method.

Groups	Mean	Standard dev.
Treatment group (taught basic science & Technology using experiential method)	57.7	14.04
Control group (taught basic science & Technology using the conventional method)	41.46	13.90

Summary of data analysis in Table 1 reveals that experiential method is superior to the conventional method in fostering pupils' achievement in basic science and technology. The table reveals that pupils taught basic science and technology using the experiential teaching approach had a mean achievement score of 57.7 with a standard deviation of 14.04 while pupils taught the same topics using the conventional method had a mean achievement score of 41.40 with a standard deviation of 13.90.

**Table 2:** Mean achievement scores of male and female pupils taught Basic science and technology using the experiential teaching approach.

Gender categories	Mean	Standard dev.
Male	48.49	15.65
Females	48.61	16.60

As shown in Table 2, the mean achievement scores of male pupils taught basic science and technology with experiential teaching method is 48.49 with standard Deviation of 15.65, while their female counterpart had a mean achievement score of 48.61 with a standard deviation of 16.60. It could be seen that the difference is very negligible.

**Table 3:** Summary of interaction between gender and teaching method on pupils' mean achievement in Basic Science and Technology

Gender/group	Mean for experiential group	Mean for conventional group
Male	48.49	41.32
Females	48.61	41.58

## Results

### Research questions

#### Research question 1

*What is the effect of experiential teaching methods on pupils mean achievement scores in basic science and technology?*

Scores of the students for the pre and posttests in both the treatment and control groups were compared. Adjusted mean was employed in the analysis. The summary of the result is presented in Table 1.

#### Research question 2

*What is the effect of experiential teaching methods on the mean achievement scores of male and female pupils' in Basic science and technology?*

To answer this question, the achievement scores of male and female pupils taught basic science and technology using the experiential teaching method were compared. Summary of the result is presented in table 2.

#### Research Question 3

*What is the interaction effect of teaching method and gender on pupils' mean achievement scores in basic science and technology?*

The scores of male and female students in both the treatment and control groups were used to determine interaction effect of method and gender on the pupils mean achievement scores. Summary of result is presented in Table 3.

The result presented in table 3 reveals that experiential method is superior to the conventional method

at the two levels of gender and therefore rules out the possibility of interaction.

### Hypotheses

**Ho<sub>1</sub>:** *There is no significant difference in the mean achievement scores of pupils taught Basic science and technology using experiential teaching method and those taught using the conventional method.*

**HO<sub>3</sub>:** *There is no significant interaction between teaching methods and gender on pupils' mean achievements scores in basic science and technology.*

Scores of pupils in both treatment and control groups were subjected to Analysis of co-variance with the pretest scores serving as the co-variates and the posttest scores as the dependent variables. Summary of the analysis for these two null hypotheses is shown in table 4.

**Table 4:** *Analysis of Co-variance for pupils' overall basic science and technology achievement scores by teaching methods with interactions*

(Source of variations)	Sum of squares	DF	Mean square	F.cal	F. cv
Covariates (pretest)	55200.459	1	55200.459	906.567	
Main effects	29415.591	2	14707.795	241.557	
Teaching methods	29407.440	1	29407.440	482.98	3.84
Gender	75.015	1	75.015	1.232	
2-Way Interaction	61.585	1	61.585	1.011	3.84
Teaching methods and gender					
Explained	84677.635	4	21169.409	347.681	
Residual	25633.623	421	60.887		
<b>Total</b>	<b>110311.258</b>	<b>425</b>	<b>259.556</b>		

For hypothesis 1, analysis of co-variance of the pupils' overall achievement scores presented in table 4 shows that the F-cal value of 482.98 is greater than the critical F.cv of 3.84 at 95% confidence level. The null hypothesis which states that there is no significant difference in the mean achievement score of pupils taught basic science using experiential teaching method and those taught using the conventional teaching method is rejected. The difference observed between the mean achievement scores of the treatment and the control groups is statistically significant in favour of the group taught basic science and technology using the experimental approach.

For hypothesis 3, the results presented in table 4 shows that the F.calculated value (1.011) is less than the

critical value of 3.84. Based on the decision rule the researchers upheld the null hypothesis and conclude that there is no significant interaction between gender and teaching method on pupils' achievement in basic science and technology.

**HO<sub>2</sub>:** *There is no significant difference in the mean achievement scores of male and female pupils' taught basic science and technology using experiential teaching method.*

This hypothesis was tested using analysis of Co-Variance for overall achievement score by experiential teaching method by gender. Summary is presented in table 5.

**Table 5:** *Analysis of Co-Variance for overall achievement of students for experiential teaching method by gender*

Source of variation	Sum of squares	DF	Mean square	F-cal	F. cv
Covariates (pretest)	24877.065	1	24877.065	397.29	
Main effects	132.850	1	132.850	2.122	
Gender	132.850	1	132.850	2.122	3.84
Explained	25009.915	2	12504.957	199.707	
Residual	11458.822	183	62.617		
Total	36468.737	185	197.128		

Summary of result in Table 5 reveals that there is no significant difference in the mean achievement scores of male and female pupils taught basic science and technology using the experiential method. As we can see from the Table the F.calculated value (2.122) is less than the critical F value (3.84) therefore the null hypothesis was retained.

### Discussion of Results

This study reveals that pupils taught basic science and technology with experiential teaching approach performed significantly better than their counterparts who were taught using the conventional approach. This study supports and



sustains earlier findings of similar experimental studies in the use of experiential teaching approaches (Okoli and Abonyi, 2014; Ajiboye and Ajitoni, 2008). Abonyi and Okoli (2014) experimented with biology students and observed that the experiential teaching approach is superior to the conventional method in fostering students' achievement in biology. In the same vein also Ibe and Abonyi (2014) linked experiential model to the constructivist approach. Their study revealed that the constructivist approach enhances students' interest in science. They argued that when interest is facilitated, achievement becomes obvious. The significant effect observed between the experiment and control groups in this study could be attributed to learners being practically and actively involved in the meaningful activities presented by the teacher, who only acted as facilitator of learning. The pupils found the activities interesting, revealing, involving, and full of fun. The satisfaction that goes along with involvement is the exploratory drive. This is the urge by learners to have a proper grasp of reality and a total exploration of his environment.

On the effects of experiential teaching approach on male and female pupil's achievement in base Science and technology the summary of result reveals uniformity in their progression implying that the method is not gender biased and therefore cost effective. This finding is in agreement with the findings of Olaoye and Omotayo (2008) that there is no significant difference between male and female in participatory methods. This is because experiential teaching approach is a gender inclusive teaching approach, as the constitution of group members in each group in the classroom ensures equal representation of males and females.

### Summary and Recommendations

This study reveals that the experiential teaching method fosters higher achievement in basic science and technology than the conventional method. It is also evident from the study that the female pupils had slightly higher mean achievement scores than the male pupils but the difference was not significant. In the same vein also there is no interaction between teaching method and gender on pupils' achievement in basic science and technology.

Based on the findings of the study the researchers recommend that the experiential approach be infused into the curriculum of basic science and technology. In addition in-service training programmes for teachers should focus on experiential approaches so that the benefits of this approach will be properly harnessed.

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