

2

Effect of Experiential Teaching Method on the Achievement of Junior Secondary School Students in Basic Science

By

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Abstract

This study investigated the effect of Experiential teaching method on the achievement of Junior Secondary School Students in Basic Science. The study employed a non-equivalent control group quasi-experimental design. Six secondary schools were drawn through stratified random sampling. In each of the schools one intact class was drawn through simple balloting. The treatment group was taught using experiential method. The instrument for data collection was the Basic Science Achievement Test. The data was analyzed using mean, standard deviation and Analysis of Co-Variance (ANCOVA). The result revealed that the Experiential teaching method is superior to the conventional method in facilitating achievement in Basic Science. The study also revealed that though females, showed higher achievement than males, the difference in the mean achievement was not statistically significant. There was no significant interaction effect between gender and instructional method. The researcher recommends that experiential teaching method be adopted in the school system.

Basic Science which formally called Integrated Science. The idea of the Nigeria Integrated Science Project (NISIP) was borne as a result of the nation's step towards presenting science to the students as a unified whole, such that students can obtain a broad view of science as shown in its many and varied aspect in the world around them. The main reason for integration is that it widens (lie knowledge of the students which enables them to appreciate the unity among science subjects. Furthermore, the recipients may gain the commonality of approach to solve problems of scientific nature (Baja. 1993).

Towards this development the Science Teachers Association of Nigeria (1970) outlined the objectives of teaching Integrated Science. These includes:

1. Observe carefully and thoroughly
2. Report completely and accurately
3. Organize information acquired
4. Generalize on the basis of acquired information
5. Predict as a result of generalization
6. Design experiments (including controls, where necessary to check the predictions)
7. Use models to explain phenomena, where appropriate; and
8. Continue the process of inquiry when new data don not conform to predictions.

To achieve these objectives, the teaching of Basic Science must be effectively carried out.

Teaching has been defined by various authors. Okeke (2007) defined teaching as an act of systematically presenting stimuli or cues to someone to facilitate learning. Hunter (1979) in his definition of teaching stated that it is a process of making and implementing decisions, before and after instruction to increase the probability of learning. It is a series of activities which are designed to produce desirable change in students' behavior, to achieve the objective of a lesson. Teaching must be systematic. In the definitions above, one thing is common i.e. teaching has to do with "Learning-". In other words teaching is contingent on learning. The attention of many science teachers has been directed at searching for appropriate methods of Science Instruction. They have focused on several dynamic and pragmatic pedagogical methods and strategies that enable learners to be active participant in the learning process.

In line with this. Ornotayo and Olaleye (2008) stated "what is expected of the teacher is to guide the learners to appreciate the worth of the learning materials", Omotayo and Olaleye (2008) maintained that through didactic teaching method "science is thus made alien rather than being a tool for industry". Teaching of Science in Junior Secondary Schools is through didactic method. Ling and Boo (2007), pointed out that the current method of teaching Science is often didactic and does not engage students knowledge effectively.

The traditional teacher centered lecture method of teaching Science at various level of education has been widely criticized as being responsible for student poor achievement in Science. Ajobye as noted by-Salami (2007) reported that "lecture method is still popular in Nigeria despite its obvious limitations". Omotayo and Olaleye (2008) also noted that "serious aberrations on the quality of Science in Nigeria is due to the

over-emphasis on mastery of subject matter content, theory and excessive examination consciousness against practical orientation toward science based disciplines". They further noted that in the present teaching method "there is total lack of participation of students in the learning process".

This causes students poor academic achievement in Junior Secondary Schools. Present day statistics on the students' performance tend to show that; the teaching and learning of Basic Science as a subject at the Junior Secondary Schools level is inadequate. For example, the data he low showed the performance of students from ten selected Secondary Schools in Abakaliki Educational Zone, Ebonyi State.

Table 1: Results of Basic Science Abakaliki, Ebonyi State

Year	Distinction	Credit	Ordinary	PassFailed	Total Students
2006	52	506	1483	6	5047
2007	59	602	1127	70	1858
2008	81	501	1071	69	1722
2009	50	553	1059	82	774

Source: (Examination Development Center, Abakaliki), 2011.

Ordinary pass is within 40%-49%. It can be seen from the above data that the performance of student in Basic Science in Ebonyi State in particular is not encouraging. This state of affairs may be attributed to the approach used in teaching and learning of the subject at Junior Secondary Schools. The researcher therefore sought for a teaching method that will enable students to achieve good result in Basic Science. The method sought for is the experiential teaching method.

Nadler (1997) define Experiential teaching method as a type of learning in which students participate in some activities, reflect upon the activities, and use their analytical skills to derive some useful insight from the experience then incorporate their new understanding into their lives. In line with this, Diem (2001) conceptualized experiential teaching as "learn by doing approach". Experiential teaching method enables students to engage in concrete activities which enable them to find out facts and meaning about concept by themselves with the guidance of a teacher. The experiential teaching approach makes learners to be active in the classroom, self explorative, gain insight into situation, acquire problem solving skills and have self understanding of environment. Experiential teaching method embodies co-operative learning, personalized system of instruction as well as affective science teaching. Students work in small

groups with concrete objects to discover facts about them. This enables learners to transfer knowledge to situation outside the learning environment (Lucker and Nadler, 1997), Mabie and Baker (1996), Richardson (1994), Grisoni (2002), and Tenick (2000).

Diem (2001) enumerated the following as the merits of experiential learning:

1. Multiple teaching (learning method) can be integrated. That is the method of integrative.
2. It is very learner centered.
3. The teaching process involves discovery which build self-esteem in learners.
4. Learning is more fun for learners and teaching more fun for teachers.
5. Others life skills can be learned instead of only science content.

In an experiential classroom teaching, emphasis is placed on the nature of participant subjective experience (Neil, 2005). The role of the teacher "is to organize and facilitate direct experience of the phenomena on the believe that it will bring about meaningful and long-lasting learning.

It has been stated that students achieve poorly in Basic Science examinations (Examination Development Center, Abakaliki 2011). The poor academic achievement in Basic Science in Ebonyi State is unsatisfactory, hence the need to find a way of solving this problem through research. The problem of this study is therefore to determine the extent to which the learning of Basic Science can be improved upon by the Experiential teaching method.

The purpose of the study was to determine the effect of Experiential teaching method on the achievement of Junior Secondary School

(J. S. S. 3) Students specifically the study sought to

1. Determine the effect of experiential teaching method on students' achievement in Basic Science.
2. Ascertain the differential effects of Experiential teaching method on the mean achievement of male and female J. S. S.3 students in Basic Science.
3. Determined the interaction effect of gender and teaching method on students' achievement in Basic Science.

The study was limited to Abakaliki Education Zone of Ebonyi State.

Research Questions

The following research Questions guided the study:

1. What is the effect of the Experiential teaching method on the mean

- achievement scores of students in Basic Science?
2. What is the effect of Experiential teaching method on the mean achievement scores of male and the female students in Basic Science?
 3. What is the interaction effect of gender and teaching method on students mean achievement in Basic Science?

Hypotheses

The null hypotheses were tested at an alpha level of 0.05:

Ho₁: There will no significant differences in the mean achievement scores of students taught Basic Science using the Experiential teaching method and those taught using lecture method.

Ho₂: There will be no significant difference in the mean achievement scores of male and female students taught Basic Science using the experiential teaching method.

Ho₃: The interaction effect of gender and instruction approaches on mean achievement scores of students in Basic Science will not be significant.

Design of the Study

The design is a quasi-experiential. Intact classes that included males and females were used for the study. The specific design the researcher used for the study is a non-equivalent control group design. There was experimental group and control group. The design is present thus:

$$\frac{y^b}{y^a} \sim x$$

$$y^b \sim x y^a$$

y^b = measurement taken before treatment.

y^a = measurement taken after treatment.

x = treatment

$\sim x$ = control group

Area of the Study

The study was conducted within Abakaliki Education Zone, Ebonyi State. Ebonyi State is divided into three Zones: Abakaliki, Onueke and Afikpo Zones.

Population of the Study

The population for the study comprised of 68, 512 Junior Secondary School 3 Students (Ebonyi State Ministry of Education) in all the Junior Secondary Schools in Abakaliki Education zone of Ebonyi State.

The J.S.S.3 was chosen because at; their level, Basic Science is compulsory for all the students. Also at their age their mind would be open to educational influence than those at higher classes.

Sample and Sampling Techniques

The sample for this study comprised of three hundred Junior Secondary School 3 Students drawn from six Schools out of 50 Government owned Secondary Schools in Abakaliki Education Zone of Ebonyi State. The Secondary Schools (2 boys, 2 girls and 2 co-educational) were drawn through a stratified random sampling. In each school, one intact class was drawn for the study (one male, one female and one co-educational) were assigned to the treatment group while the remaining three schools were assigned to the control group. The assignment of the schools to the treatment and control group was done through a stratified random sampling. The distribution of research subjects in the intact classes for the study is shown in table 2 below.

Table 2: Distribution of Research Subjects (Students) in the Various Classes Used for Study

GROUP	Name of School	No of Male	No of Female	Row Total
Treatment Group	(Girls High School Abakaliki	-	48	48
	Boy Secondary School Nnodo	49	-	49
	C.S.S. Nwofe Agbaja (Co-Educational)	28	25	53
Subtotal				150
Control Group	Model Girls High Sch. Abakaliki	47	-	47
	Boys High School Iboko Community S.S. Effium (Co-Educational)	-	45	45
		29	29	58
Subtotal				150

For experimental group, a total of one hundred and fifty J. S. S. 3 students were used (77 males and 73 females) while for the control group a total of one hundred and fifty students J. S. S. 3 student (76 male and 74 females) were used.

Instrument for Data Collection

The instrument for data collection is Basic Science Achievement Test (BSAT), the instrument consists of twenty multiple-choice items. The instrument contains four options A—D for each of the twenty items. The instrument was used for both pretest and post test.

Validation of the Instrument

The instrument was validated by experts in Basic Science Education and in measurement and evaluation, in Ebonyi State University, Abakaliki. They subjected the instrument to both face and content validation. BSAT was face validated by the experts in terms of clarity of instruction, proper wording of the items, appropriateness and adequacy of the items, in addressing the purpose and problems of the study. The experts also validated the test blue print used in constructing the items of the test. The test blue print is shown in table 3 below.

Table 3: Test Blue Print for Twenty-Item Test

Content Disease Vector	Knowledge	Comprehension	Application	
The life cycle of selected disease vector	3	2	2	7
General features/use of eh knowledge of life cycle in controlling disease Vector	3	2	2	7
The control of disease Vector	2	2	2	6
	8	6	6	20 item

Reliability of the Instruments

The reliability of an instrument is *the* consistency of the instrument in measuring whatever it is designed to measure. The reliability of BSAT was determined using" Kuder-Richardson's formula (KR-20). The choice of (KR-20) is influenced by the fact that it is best used in multiple-choice item

with right and wrong answers (Harsor Peter, 1997). A reliability coefficient of 0.76 was obtained.

Experimental Procedure

At the onset of the experiment, subject in both treatment and control groups were given the pre-test. After the pre-test, the regular Basic Science Teachers started the experiment in their respective schools adhering strictly to the lesson procedure developed from the packages during the pre-experiment conference. The pre-experimental conference was used as a training programme to train the regular teachers serving as research assistant on the essential steps using the experiment; and control teaching approaches. The experiment was conducted during the normal school periods following the normal time table of the schools. At the end of the experiment, which lasted for 6 weeks, the teachers administered the post-tests to the subject in the two groups. Data collected from the pre-test and post-test were kept separately for the two groups and were used to answer the research questions and test the hypotheses that guided the study

Control of Extraneous Variable

The researcher adopted the following procedure to ensure that extraneous variables which might introduce bias into the study were controlled:

i. Teacher Variable

To control the errors which may arise as a result of teachers' difference, the researcher organized a pre-experimental conference for the teachers that were used for the study. Separate conferences were conducted for teachers in the two groups (treatment and control). The conference helped to establish a common instructional standard among the instructions. The researcher also used the opportunity of the conference to detect individual problems of the teachers that may introduce errors to the study. It was agreed at the conference that everyone involved in the study would adhere strictly to the specifications of the packages to ensure uniformity. The teachers conducted the experiment in their individual's school and individuals classes. The study was regularly monitored by the researcher to ensure that teachers do not deviate from the normal procedure of instruction.

ii. Instructional Situation Variable

To ensure that instructional situations is the same for all the school, the researcher issued out instructional guides to the teacher in each group. The teaching was conducted in all the J. S. S. III classes in the various schools used for this

study and not just in the intact classes drawn for the study. Thus was to avoid Hawthorne effect. Pre-test was also administered to all the classes but post-test was restricted to the intact class chosen for the study.

iii. Inter-Group Variable

The researcher did not select treatment and control group from the same school to ensure that the students in the treatment and control groups do not mix up at all. This is to reduce the errors arising from interaction and exchange of ideas among research subjects from the two groups and further eliminate the possibility of a John Henry effect.

iv. History

This was controlled by ensuring that the experiment does not last too long. Moreover, there is no extraordinary event that occurred during the period of the study.

v. Testing

To check the effect of testing, the items in the instrument BSAT was re-arranged after the pretest. The colour of the paper was also changed.

vi. Initial Equivalent

ANCOVA was used to control the initial difference of the groups

Method of Data Collection

At the on set of the experiment, the teachers administered the pretest to the students. Scores of the students on the pre-test were recorded and kept behind for use after the experiment. At the end of the experiment, the post-test was administered to only the intact classes chosen for the study. Although all the classes received equal treatment in terms of receiving the pre-test and being taught along with others, data for the study was restricted to the intact classes that were used for the study.

Method of Data Analysis

Descriptive statistics of mean and standard deviations were used for achievement score while inferential statistics, ANCOVA was used to test relevant hypotheses.

Findings

For research Question I, data obtained from Basic Science Achievement Test administered to research subjects in both the treatment and control groups were used to answer the research questions.

Summary of results obtained for the two groups is shown in table 4 below.

Table 4: Mean Achievement Scores of Students Taught Basic Science with Experiential and Conventional Package

Groups	Mean (x)	Standard Deviation
Group 'A' (Group taught Basic Science with Conventional Method)	78.67	17.24
Group 'B' Group taught Basic Science with Convention Method)	63.79	11.68

Experiential method yielded a mean achievement score of 78.67 with a standard deviation of 17.24 while the conventional package yielded a mean of 63.79 with a standard deviation of 11.68. This indicates that a clear difference of 14.88 exist between the mean achievement scores of the treatment group and control group. The difference is in favour of the treatment group. The result agreed with Abonyi (1998) that the achievement scores of experiments group taught ethno-Science-based instructional package on students' conception of scientific phenomena and interest in science is higher to those taught with lecture method.

Research Question 2

What is the effect of the Experiential Teaching Method of Instruction on mean achievement of male and female students in Basic Science?

For this research question, the Basic Science achievement; Scores of male and females taught Basic Science using experiential teaching method were separated. The summary is shown in table 5 below.

Table 5: Mean Achievement Scores of Males and Females Taught Basic Science Using Experiential Teaching Package

Groups	Mean (x)	Standard Deviation
Males taught Basic Science using The Experiential teaching Method	77.47	22.03
Females taught Basic Science using the Experiential teaching Method	80.17	21.69

The result form the table showed that the female obtained a mean score of 80.17 and standard deviation of 21.69 which is slightly higher than the male that

obtained 77.47 with standard deviation of 22.03. However, the difference is negligible.

Research Question 3

What is the interaction effect of gender and teaching methods on the students mean achievement in Basic Science?

Table 6: Interaction between Gender and Instructional Approach on Students Achievement in Basic Science

Gender Groups	Experiential Based	Conventional Based
Males	77.47	62.07
Female	80.17	65.22

The result in table 5 reveals clearly that there is no interaction between gender and teaching method *on* student's achievement in Basic Science. The result indicated that Experiential teaching method is superior to the conventional approach at the two levels of gender (male and female).

Ho₁: There is no significant difference in the mean achievement scores of students taught Basic Science using Experiential teaching method and those taught using the conventional method.

Ho₂: There is no significant difference in the mean achievement scores of male and female students taught Basic Science using Experiential teaching method.

Ho₃: There is no significant interaction between gender and approaches on students' mean achievement scores in Basic Science.

These hypotheses were tested using analysis of co- variance. Summary of the analysis for the three hypotheses is shown in table 6 below.

Table 7: Analysis of Co-Variance (ANCOVA) for Student Achievement Scores by Instructional Approaches and by Gender

Sources of Variance	Sum of Squares	Df	Mean Squares	F	Significance
Covariates	17.550	1	17.550	0.81	
Main Effects	3379.003	1	1689.502	7.777	
Gender	125.732	1	125.732	579	4.02
T. Method	3369.995	1	3369.995	15.513	4.02
2-way interactions	.248	1	248	0.002	.960
Gender dt. Method					
Explained	3435.089	4	858.772	3.953	.000
Residual	11947.894	55	217.234		
Total	15382.983	59	260.729		

For hypothesis 1, the ANCOVA table shows the F-cal 15.513 is greater than the critical value (4.02) at an alpha level of 0.05. The decision rule is to reject the null hypothesis when the calculated value exceeds the critical value at a given possibility level.

Since the calculated value is greater than the critical value, the null hypothesis was rejected. The researcher, therefore, concludes that there is a significant difference in the mean achievement scores of students taught Basic Science using Experiential teaching method and those taught using conventional method.

For hypothesis 2, Data from the treatment group only were used for the analysis, summary of the ANCOVA test is presented in the table below.

Analysis of Covariance (ANCOVA) for Students' Scores by Gender

Source Variation	Sum of Squares	Df	Mean Square	F.cal	F.cro
Covariates	112.193	1	112.193	.356	
Main Effects(genders)	75.009	1	75.009	.238	4.22
Explained	60.793	2	80.396	.255	
Residual	7567.207	24	.15.300		
Total	7728.000	26	297.231		

Summary of the result in the table 8 above is that the F-calculated value is 0.238 while the critical value at 0.05 level of significance is 4.22. Since the calculated value is less than the critical value, the researcher uphold the null hypothesis and concludes that there is no significant difference in the man achievement of male and female students taught Basic Science using experiential teaching method.

For hypothesis 3, result reveals that for two way interaction, the F-calculated is (0.002) while the critical value at 5% possibility level is (96.3). Based on the decision rule, the researcher upholds the null hypothesis and concluded that there is no significant interaction between gender and instructional approach on student's achievement in Basic Science.

Discussion of Findings

Experiential teaching method fostered higher achievement in Basic Science than conventional package. Experiential teaching method is therefore superior to conventional method in facilitating and fostering higher achievement among students. The finding of this study with regard to Eze (1993) Iloputaife (1995), Maduabum (1995), Nwagbo(1997), and Abonyi (1998), that there is no significant difference between the achievement of boys and girls in various subjects. Nevertheless, the finding of this study disagrees with other findings that shows that boys are superior to girls in their achievement in various science subjects. Such finding include those of Okeke (1997), Hacker (1992), Azuogu (1990) Macker (1992) hence the study on gender as a factor in students' achievement is inconclusive. The female students taught Basic Science using experiential teaching method showed an insignificant higher achievement in Basic Science than males.

Summary of result presented in table 6 reveals that there is no interaction between gender and teaching approach on student achievement in basic science. Summary of result in table 6 also indicate that experiential teaching method is superior to the conventional (lecture) method at the two levels of gender in fostering achievement. Treatment interaction generally implies that different learner with different characteristics may profit more from one type of instruction than from another and that therefore it may be possible to find the best match of learners characteristics and instructional approach in order to maximize learning outcomes on whichever dependent variable that is involved.

Conclusions

From the results obtained in the investigation into the Effects of Experiential Teaching Method on Students achievement in Basic Science, the researcher draws the following conclusion:

1. The experiential teaching method is more effective than the conventional package in fostering achievement in Basic Science. The difference between the mean achievement for students in experiential teaching method group and conventional group is statistically very significant and in favour of the experiential group.
2. Although with experiential teaching method, females show higher achievement than males, the difference in the mean achievement of male and female taught Basic Science using experiential teaching method is not statistically significant.
3. There is no significant interaction between gender and instructional approach on students¹ achievement in Basic Science for both males and females. The experiential teaching method is superior to the conventional package in fostering achievement in Basic Science.

Recommendations

Based on the findings of the study, the researcher made the-following recommendations:

1. Teachers should be trained on the use of Experiential teaching method. Workshops, seminars and conferences should be organized for teachers to familiarize them with the method.
2. Experiential teaching method should be adopted in schools system. The current curriculum should be reviewed in terms of basic instructional approaches to incorporate basic experiential model so that Basic Science instruction will be improved in school system.
3. Teachers should give more attention to realistic situation in which experiential method exist and apply science. Moreover, the conventional instruction approach should be de-emphasized in school system. This study revealed its inadequacy in fostering achievement in Basic Science.

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