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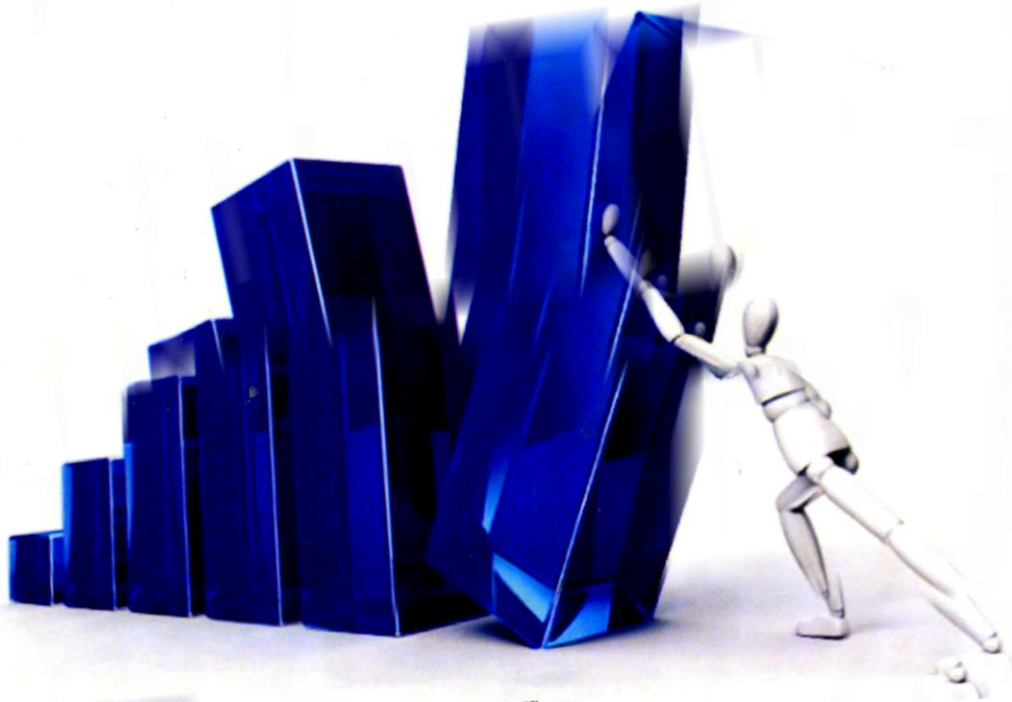
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Comparative Effects of Practical and Alternative to Practical Methods on Students' Academic Performance in Biology

Olutola, Adekunle T.
Department of Educational Foundations,
Faculty of Education,
Federal University, Dutsin-Ma, Katsina State, Nigeria.
aolutola@fudutsinma.edu.g

Daramola, Dorcas S[1]. & Bamidele, Esther O.[2]
Department of Social Sciences Education,
Faculty of Education, University of Ilorin, Ilorin.
immaculatetabitha@yahoo.com[1]
estherbamidele23@gmail.com[2]

Abstract

The study investigated the comparative effects of practical and alternative to practical methods on students' academic performance in Biology in Ilorin, Nigeria. Two senior secondary schools (SSS) in Ilorin metropolis were randomly chosen and intact science class of SSS 3 in each of the chosen school was selected for the study. Students in the first school were taught and assessed using practical method while their counterparts in the other school were taught and assessed using alternative to practical method. The researchers' designed Biology Practical Test 1 (BPT 1) and Biology Practical Test 2 (BPT 2) with Cronbach's alpha reliability coefficient of 0.73 (Pre-test) and 0.82 (Post-test) were used to obtain data for the study. The data collected were analysed using Analysis of Covariance (ANCOVA). Findings revealed that there is a significant effect of practical methods on secondary school students' performance in Biology. In addition, there is no significant effect of gender on students' academic performance in Biology and there is no significant interactive effect of gender subject combinations and practical methods on students' performance in Biology. Based on these findings, it was recommended that secondary school administrators and Biology teachers should allow male and female Biology students to participate actively during the weekly Biology practical lessons.

Key words: Biology, Practical Methods, Students Performance,

Introduction:

Science has been accepted as yardstick by which development is measured globally. It improves the economy of any nation and is an instrument for achieving national development. Science is the key to technological growth and has played an

important role in improving the lives of mankind through medicine, agriculture, communication, transportation, engineering and economy. According to Olurundare (2011), the development of any nation is usually measured by the degree and extent of socio-cultural, socio-economic and political improvements that are brought to bear through the enterprise of science and technology. One emphasis of the Nigerian educational policy is that scientific and technological education must be acquired (FRN, 2013).

Okorie (2002) defined science as the study of nature or environment through which people can develop both enquiry and disciplined logical power of thought. Clavar (2005) opined that science and technology education for the different aspects of national development should be considered a priority action area, as such, needs to receive special attention in the light of national needs and reality. Ajiboso (2005) sees science as a human enterprise which uses systematic and reproducible process to provide explanation and information about nature and phenomenon.

Nations depend on science to advance technologically. Adesokan (1999) highlighted methods of imparting scientific knowledge to the students, as that; teaching approach should be students centered; emphasis should be on scientific and experimental literacy; learning should be through inquiry rather than dogma and process approach should be emphasized. Bassey (2005) observed that world strongest economic nations like Japan, United State of America (USA) and China are nations that have invested and committed sufficient amount of financial and human resources to the development of science and technology education.

In the school setting, students performance in the science subjects has implications for the attainment of vision 20:20:20. Moreover, Biology is one of the science subjects in senior secondary school. It deals with the study of living things both the plants and animals. Biology is a subject that teaches scientific facts relating to living things starting from the animal to plant kingdom. It takes into account interaction between living and non-living things and many other activities such as theoretical and experimental activities by which a human being tries to find solutions to his every day's problems (Olatunji, 2004). According to Parker (1992), Biology embraces those

principles of widest application to the origin, growth and development, structure, function, evolution and distribution of plants and animals. It is also the bedrock upon which some science subjects derive their being (origin). Biology offers opportunities for:

i. understanding the basic principles of life and the position of man among other living things,
ii. acquisition of scientific methods or processes such as careful observation, measuring, data collection, drawing accurate inference and conclusion during experimentation,
iii. acquisition of scientific attitudes such as curiosity, objectivity and honesty,
iv. provision of possible vocations such as agriculture, medicine and pharmacy,
v. improving our general health standards through proper sanitary behaviour,
vi. knowledge of the careful maintenance of our natural resources such as wildlife, forests, streams and soil,
vii. appreciation of nature through acts like admiration of beautiful surroundings, birds watching, growing of flowers and caring of plants and animals and
viii. Development of enquiring mind through making observations of nature and answering biological questions (Eluwa, Soyinbo, Fajembola and Ohazuruike, 1991).

Biology is a core subject in the study of many biological science courses such as Medicine, Nursing, Physiology, Biochemistry, Microbiology, Pharmacy, Biotechnology and so on which contributes immensely to the technological growth of the nation. It is obvious that no student intending to study these disciplines can do without Biology. Practical activities are important aspect in Biology class and no student can avoid it if he wants to pass with good grade.

In addition, practical activities in Biology provide opportunities for students to actually mastered science and opposed to learning about science (Nwagbo & Chukelu, 2011). Nzewi (2008) asserted that practical activities can be regarded as a strategy that could be adopted to make the task of a teacher (teaching) more real to the learners as opposed to abstract or theoretical presentation of facts, principles and concepts of subject matters.

Laboratory experiments (activities) are characteristics features of science teaching at all levels of education (Adane & Adams, 2011). Today, it is rare to find any science course or subjects without standard component of practical or laboratory activity in institutions. Students have a lot to benefit from practical which may include increasing students' interest and abilities in science subjects as well as their achievement in science (Pavesic, 2008). In addition, Tobin (1990) and Ikeobi (2004), stated that, meaningful learning is possible from a given laboratory experiments if the students are given ample opportunities to operate equipments and materials that help them to construct their knowledge of phenomena and related scientific concepts. There are reports that emphasize teaching a science with the help of laboratory experiments to be more enjoyable and stimulating to students than teaching the same subject matter only through lecture (Hof- stein, 2004; Teibo, 2001).

Moreover, the Alternative to Practical paper is simply an alternative mode of assessment to the Practical Examination paper. It requires the same kind of practical work in preparation as the Practical Examination paper (Cambridge International Examinations, 2016). Alternative to Practical paper assesses students' practical skills, including both data handling and familiarity with standard laboratory equipment. Any candidates without experience of doing practical work will be disadvantaged in this paper. In addition, students without practical knowledge will not be able to perform well in the alternative to practical paper or examination.

The acquisition of process skills has persisted over the years. This is because, the acquisitions of science process skills are the bases for scientific inquiry and the development of intellectual skills and attitudes that are needed to learn concepts (Nwago & Chukelu, 2011). Ibe (2004) asserted that science process skills are abilities which can be developed by experience and used in carrying out mental and physical operations. Thus, science process skills serve as solution to scientific problems. Despite the important of Biology to other field and the huge investment in education the performance of students in Biology in senior secondary certificate has been a matter of concern to many well-meaning individuals, institutions and organizations as well as to various levels of government (Kpolovie, Ololube & Ekwebelem, 2011). In spite of the importance and

popularity of Biology among Nigerian students, performance at senior secondary school level had been poor. The table below shows the performance of students' failure rate from 2010-2012.

Table 1: Percentage of students failure rate in Some Science Subjects in WASSCE from (2010–2012)

Subject	% of Failure 2010	% of Failure 2011	% of Failure 2012	Average Failure	Rank
Biology	22.86	29.34	33.77	28.66	1
Mathematics	27.20	27.95	18.01	24.39	2
Chemistry	21.08	22.82	23.65	22.52	3
English	31.02	18.22	16.44	21.89	4
Physics	18.27	11.76	09.20	13.8	5

Source: WAEC, 2012

Table 1 above show the percentage failure rate of students sat for WAEC science subjects between 2010 -2012. Students' percentage failure rate in Biology is higher than other science subjects. This performance has affected the popularity of Biology among students.

WASSCE Chief Examiner's Reports Nov/Dec. (2004) shows that the mean for Biology paper 2 (Essay) was 22 while the standard deviation was 8.94. Students' performance in this paper was fair compared with previous years. But, the performance of the candidates was poorer than the previous year in paper 3 (alternative to practical). WASSCE Chief Examiner's Reports Nov/Dec (2007) indicate that the performance of the students in paper 2 (Essay) was slightly poorer than that of the previous year with a mean score of 17 and a standard deviation of 8.77 compared to a mean of 18 and S.D of 8.94 for Nov/Dec 2006.

In addition, students performance in paper 3 (alternative to practical) was slightly poorer in 2007 with a mean score of 24 and a standard deviation of 12.17 compared with a mean of 28 and standard deviation of 7.64 for Nov/Dec 2006 WASSCE.

The desire to know the causes of the poor performance in Biology has been the focus of researchers for some time now. Gender issues too have been linked with performance of students in academic tasks in several studies but without any definite conclusion. Spence (2004) found no significant influence of gender on the achievement of college students in mathematics when they were exposed to mathematics courseware in online and traditional learning environment. Some studies revealed that male students perform better than the females in physics, chemistry and Biology (Danmole, 1998; Novak & Mosunda, 1991). The role of gender in academic performance of students in the school subjects cannot be overstated. In Nigeria, there is abundant evidence that our senior secondary school students find it difficult to attain high academic performance in Biology.

This study is therefore interested in seeing how practical methods could be used to improve learning, students' performance and institute educational reform. Therefore, this study is designed to investigate the comparative effects of practical and alternative to practical methods on students' academic performance in Biology. It aims to investigate whether practical methods will improve students' academic performance in Biology.

Research Hypotheses

The following null hypotheses were formulated for this study.

1. There is no significant effect of practical method on secondary school students' performance in Biology.
2. There is no significant effect of practical method on secondary school students' performance in Biology based on gender.
3. There is no significant interactive effect of gender subject combination and practical method on secondary school students' performance in Biology

Methodology

The pretest–posttest quasi experimental research design with one experimental group and one control group was adopted for the study. Two senior secondary schools in Ilorin metropolis were selected for this study. The science arm of senior secondary three (SS2) in each of the sampled schools participated in the study. The sample for the study consisted of sixty-five (65) senior secondary school two (SS2) students made up of thirty-one (31) males and thirty-four (34) females drawn from two randomly selected coeducational secondary schools in Ilorin metropolis. These students were assigned into one experimental group and one control group. All members (intact class) of these sampled classes participated in the study. The hypotheses in the study were tested using a 1 X 2 factorial model. The factors included treatment at 1 level (Practical Biology Test) and Gender occurring at 2 levels (male and female).

Biology instructional modules were developed for SS3 students by the researcher based on the SSCE syllabus. The students were taught four topics. These four topics were broken into twelve (12) teaching lessons. Each topic was taught within three (3) periods of 45 minutes each per week. The experiment lasted for four weeks. Treatment was assigned to one experimental group (Practical Method) and placebo was administered to the control group (Alternative to Practical Method).

Both the experimental and control groups took pretests and posttest. The students in experimental group were taught with different specimens while students in the control group were taught without specimens but went through only the pretest and posttest. The researchers' designed Biology Practical Test 1 (BPT 1) and Biology Practical Test 2 (BPT 2) with Cronbach's alpha reliability coefficient of 0.73 (Pre-test) and 0.82 (Post-test) were used to obtain data for the study. This shows that the instruments were reliable. The pretest was made up of (20) Biology practical test items and a posttest made up of (20) Biology practical test. The instruments were validated by ensuring that all Biology practical test items were developed from the topics and contents presented to the two groups and the face validity of the instruments were established by the Biology teachers in each of the school. The data collected were analysed using Analysis of Covariance (ANCOVA) statistics.

Results

Hypothesis One: *There is no significant effect of practical methods on secondary school students' performance in Biology.*

Table 2: ANCOVA Summary Table of Practical Methods on Students' Performance in Biology

Source	Sum of Squares	DF	Mean Square	F	Sig.
Corrected Model	4016.130[a]	2	2008.065	17.714	.000
Intercept	823.322	1	823.322	7.263	.009
Pretest	116.068	1	116.068	1.024	.316
Practical Methods	3770.172	1	3770.172	33.259	.000
Error	7028.270	62	113.359		
Total	100994.000	65			
Corrected Total	11044.400	64			

For hypotheses one, results on Table 2 reveals the calculated F-ratio of 33.259 with an F(p) value of 0.000. Since the F(p) value of 0.000 is less than 0.05, the null hypothesis was rejected. Thus, it was concluded that practical methods significantly affects secondary school students' performance in Biology.

Hypothesis Two: *There is no significant effect of practical method on secondary school students' performance in Biology based on gender.*

Table 3: ANCOVA Summary Table of Practical Methods and Gender on Students' Performance in Biology

Source	Sum of Squares	df	Mean Square	F	Sig.
Pretest	248.183	1	248.183	1.425	.237
Gender	2.425	1	2.425	.014	.906
Error	10796.017	62	174.129		
Total	100994.000	65			
Corrected Total	11044.400	64			

For hypothesis two, Table 3 shows that the calculated F-ratio of 0.014 with (F (p) value of 0.906. Since F (p) value of 0.906 is greater than 0.05, the null hypothesis was accepted. This result implies that gender has no significant effect on the students' academic performance in

Biology.

Hypothesis Three: *There is no significant interactive effect of gender subject combination and practical method on secondary school students' performance in Biology.*

Table 4: ANCOVA Summary Table of Interactive Effect of Gender Subject Combination and Practical Methods on Students' Performance in Biology

Source	Sum of Squares	df	Mean Square	F	Sig.
Posttest	354.471	1	354.471	9.821	.003
subjcomb	2801.110	2	1400.555	38.804	.000
Practical Method	.395	1	.395	.011	.917
Gender	1.022	1	1.022	.028	.867
Subjcomb * Practical Method	14.108	2	7.054	.195	.823
Subjcomb * Gender	99.070	2	49.535	1.372	.263
Practical Method * Gender	24.748	1	24.748	.686	.411
Subjcomb * Practical Method * Gender	27.050	2	13.525	.375	.689
Error	1876.850	52	36.093		
Total	290315.000	65			
Corrected Total	5191.538	64			

For hypothesis three, Table 4, reveals a calculated F-ratio of 0.375 with a p value of 0.689. Since, F(p) value of 0.689 is greater than 0.05, the null hypothesis four is accepted . It implies that there is no significant interactive effect of gender subject combinations and practical methods on students' performance in Biology.

Discussion of Findings

The findings of the study revealed that there is significant effect of practical methods on secondary school students' performance in Biology. Therefore, practical method is an important factor in predicting student performance in Biology in secondary school. This finding was supported by Mari (2001) who confirmed that male students' performance in a test of practical Biology enhanced male students' performance in NECO SSCE Biology practical. Also, Usman (2000) finding supported the result of this study; he found that

female students' performance in practical aspect of Biology internal examination enhanced their performance in external examinations. Asoegwu (2008) agreed with findings of this study, the researcher found that female students' performance in a test of practical knowledge Biology predicted their performance in NECO Biology practical.

In addition, the study discovered that there is no significant effect of practical methods on secondary school students' performance in Biology based on gender. However, the observation that male students performed equally well as their female counterparts is supported by Akande's (2001) study in which it was observed that gender has no significant effect on students' academic performance. This study is contrary to the findings of Spence (2004) which found no significant influence of gender on the achievement of college students in mathematics when they were exposed to mathematics courseware in online and traditional learning environment. Some studies revealed that male students perform better than the females in physics, chemistry and Biology (Danmole, 1998; Novak & Mosunda, 1991). Aremu (1999) reported that boys are better than girls in Mathematics and other science subjects. Toh (19

93) found that girls out performed boys in some other school subjects. Okwo and Otunba (2007) reported that boys performed better than girls in physics essay test. The joint influence of cognitive style and gender on the achievement of students in physics essay test was significant. Also, Hedges and Nowell (1995) found no or slight gender differences in overall mathematics achievement, numerical ability, mathematics computation, concepts, and problem-solving. While females used to lag behind males in a number of mathematics and science courses taken, in 2000, they now participated in the same or nearly the same number (Coley, 2001).

Moreover, it was also found in this study that there is no significant interactive effect of gender subject combination and practical method on secondary school students' performance in Biology. This means that students' academic performance in Biology cannot therefore be attributed to the interaction of gender subject combination (Arts, Commercial and Science) and treatment conditions (practical methods). This result is supported by the findings of Iloputaife (2001) and Ibe (2004) who found no significant interaction effect between instructional methods on gender performance.

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