



EFFECT OF INTEGRATING THEORY WITH PRACTICAL ON STUDENTS' ACHIEVEMENT IN BIOLOGY

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ABSTRACT

This paper examines the effect of integrating theory with practical on students' achievement in Biology. The sample consists of 400 students selected from two urban and two rural co-education secondary schools in Otukpo. A quasi-experimental design was adopted for the investigation, and intact classes were used for data for both the experimental and control groups. The instrument used for data collection was Biology Achievement Test (BAT) which was validated by experts in Science Education. The reliability coefficient was 0.37 for pre-test and 0.60 for post-test respectively. Four research questions and three hypotheses were stated. The t-test statistical tool and analysis of covariance (ANCOVA) were adopted for analysis. The findings showed that experimental group performed significantly better than the control group. The ANCOVA showed that the difference between the urban and rural schools, boys and girls is significant when Biology is taught through integrating theory with practical. Based on the findings some recommendations were made.

INTRODUCTION

The National Core Curriculum for Biology (Federal Ministry of Education FME; (1985:20) has the following cardinal objectives which are to prepare pupils to acquire.

- Adequate laboratory and field skills in biology
- Meaningful and relevant knowledge in biology
- Ability to apply scientific knowledge to everyday life in matters of personal and community health and agriculture.

- Reasonable and functional scientific attitudes.

In accordance with the stated objectives, the contents and contexts of the curriculum place emphasis on field studies, guided discovery, laboratory techniques and skills coupled with conceptual thinking. This curriculum is intended to provide modern biology course as well as to meet the needs of the society through relevance and functionality in its content, method, processes and application.

It was reported that biology teachers organize practical lessons separately after the theory aspect of the topic(s) have been taught. This practice goes contrary to the stated objectives in the biology curriculum, therefore adequate acquisition of process skills such as observing, measuring, collecting data, experimenting etc, interest in the subject and conceptual thinking cannot be developed. The West African Examination Council (WAEC) Chief Examiners report (1998), identified the candidate's poor achievement in their approach to answering questions, lack of understanding of basic concepts and learning skills needed for success in biology, poor study habits and absence of well-equipped laboratories.

According to James (2000) one popular method of teaching biology at the senior secondary schools in Nigeria today is to collect plant and animal materials for observation and dissection in the laboratory in form of laboratory demonstration conventionally called practical. This instructional strategy does not allow active participation of students and it does not make learning meaningful, relevant and functional in biology. Today's science teaching and learning have become more active-oriented and more student-centered as reflected in the national core curriculum for biology and other science subjects. Problem solving is a primary characteristic and the learner does not just read about science but he "does" science. There is increased laboratory activity and the learner is encouraged to "find out" more knowledge about the "moving" universe.

To divorce practical from theory shall place the vast majority of students in a situation where they find science concepts and principles difficult to grasp. Practical work in this context is defined as the learning experiences in which there are interactions with apparatus and chemicals so as to improve the power of observation of the instances of scientific principles or concepts (Busari; 1996).

One of the purposes of integration is to enhance curiosity and development of scientific skills among those studying biology and other science subjects. When students are more interested and curious in the teaching-learning process, their performance shall also be improved. Integration here means

doing practical work alongside with the theoretical explanations of the concepts and principles. This implies that practical work forms an integral part of the lesson. This can be done in such a way that the students are simultaneously taught the concepts and skills as the lesson progresses. (Ona, 2007).

Statement of problem.

One major problem of teaching biology in our secondary schools is the lack of teaching strategy that would enable the students understand the concepts and principles as well as acquire the necessary process skills. The separation of theory lessons from practical activities might be the reason why students fail to relate what is learnt in the theory lesson with practical activities. It is possible that this method of teaching biology contributed to students' poor achievement in biology. The problem simply put is, how can integration of theory with practical help to improve students' achievement in biology?

Purpose of the study

In specific terms, the study is designed to find out:-

- i. The effect of integrating theory with practical in biology on the achievement of boys and girls.
- ii. Whether there could be improvement in students' achievement in biology when exposed to theory integrated with practical.
- iii. The effect the location of school (urban/rural) may have on students' achievement when theory is integrated with practical in biology.

Research questions

1. What is the mean achievement score of biology students when they are taught biology with theory integrated into practical?
2. To what extent do boys and girls exposed to the classroom situation of integrating theory with practical differ in their achievement in biology?
3. How does the location of the school (urban/rural) affect students' achievement in biology when theory is integrated with practical?

Hypothesis

The following null hypothesis were formulated and tested at the 0.05 level of significance.

H₀₁. There will be no significant difference in the mean achievement score of students taught biology through integrating theory with practical and their counterparts taught biology without theory integrated with practical.

H₀₂. The location of the school will have no influence in the achievement score of students taught biology through integrating theory with practical.

H₀₃. There will no significant difference in the mean achievement score of boys and girls taught biology through integrating theory with practical.

Population

All senior secondary school year one (SSS1) students in 98 secondary schools in zone C of Benue State Nigeria, constitute the population for the research study.

Sample of the study

A total of 400 students were randomly selected from four schools comprising two schools from urban and two schools from rural areas. The subjects of the study were made up of senior secondary school year one (SSS1) who offered biology. Simple random sampling technique was used in selecting the subjects in their intact classes. One school each from the urban and rural areas were assigned experimental group and control group.

Validation of the instrument.

The test items were based on the concepts and skills which the students learnt during the lesson. And to ensure the content validity of the instrument, a table of specification was used for its construction. The instrument was given to experts in the test development for their comments.

Reliability of the instrument

The instrument for this research consisted of a testing instrument, Biology Achievement Test (BAT). BAT was short answer questions on practical achievement test which was used for both pre-

test and post-test. The reliability coefficient using the Kuder- Richardson formula 21 was 0.37 and 0.60 for the pre-test and post-test respectively.

Research design

The study adopted the pre-test/post-test design. Quasi-experimental design whereby intact class, which constitute naturally arranged groups of students were used. Specifically, the non-equivalent control group design was used. In this design, intact classes was adopted. Two schools each from urban area and the rural area constituted the control and experimental groups respectively. These are Government Model Secondary School Otukpo, St. Francis College Otukpo, G.S.S Atilo and Federal Government College Otobi.

Instrument for data collection

The instrument used for this research was the teacher-made Biology Achievement Test (BAT). The test covered both the theoretical and practical aspects of the topics treated. The topics treated were cell structure, photosynthesis and animal nutrition. The test was made up of section A comprising short-answer questions and section B, alternative to practical questions. On the whole, there were 20 items of the questions. The items of the test were designed to assess students in three cognitive levels of Bloom’s (1956) taxonomy of educational objectives namely, knowledge, comprehension and application.

Table 1: Table of specification for construction of test items

Content	Cognitive levels			
	Knowledge	Comp.	Appl.	Total
The cell structure	2	3	1	6
Photosynthesis	4	3	2	9
Animal nutrition	3	1	1	5
Total	9	7	4	20

Experimental procedure

A pre-test was administered to the sampled subjects in their intact classes. This lasted for 1 hour. To achieve the objective of the study, the subjects were subjected to some form of formal instruction that lasted for two months. Graduate teachers of long experience with specialization in biology were used as instructors or research assistants. The researcher provided written lesson notes as a guide to the instructors to be used for the experimental class and another for the control class. The study was designed in such a way that the instructors or research assistants taught all the topics in the experimental and control classes.

The method of teaching in the experimental group was the inquiry method whereby the concepts were simultaneously taught with practical activities. There was no separate theory and practical lessons in the experimental group. In the control group, the method of teaching was the expository type and practical activities were separated from the theory. The questions that were administered as pre-test were also given as post-test after the formal instruction in the class. To avoid the transfer effect from pre-test to post-test, the question numbers were altered and the colour of the paper was changed.

Methods of data Analysis

The pre-test and post-test scores obtained from the administration of the teacher made biology achievement test (BAT) instrument was analyzed using mean to answer research questions. T-test of independent mean was used to test hypothesis 1. The analysis of covariance (ANCOVA) was used to analyze hypothesis 2 and 3.

Presentation and Analysis of Data

Research question 1: What is the mean achievement score of biology students when they are taught biology with the theory integrated with practical?

Table 2: The pre-test and post-test mean scores of the experimental and control groups.

	N	Experimental group		Control group	
Type of test		Mean	Standard deviation	Mean	Standard deviation
Pre-test	20	51.54	9.65	46.60	6.86
Post-test	20	72.60	15.42	53.85	9.90
Total	40				

Table 2 shows that the experimental group taught biology with theory integrated with practical using the inquiry method had mean achievement score of 72.60, while the control group taught biology with theory separated from practical using conventional method had a lesser mean score of 53.85. It can be observed that the experimental group performed better than the control group.

Research question 2: To what extent do boys and girls exposed to the classroom situation of integrating theory with practical differ in their achievement in biology?

Table 3: comparison of the mean achievement score of boys and girls taught biology through theory integrated with practical.

Sex	N	Mean	Standard deviation
Boys	15	59.7	11.73
Girls	15	54.9	9.97

Results in table 3 above shows that the boy's performance in biology was better than that of the girls. One of the reasons for this difference between boys' and girls' performance could be that the boys were more active and dominating than the girls in practical lessons.

Research question 3: How does the location of the school (urban/rural) affect students' achievement in biology when theory is integrated with practical?

Table 4: Distribution of the mean achievement scores of urban and rural students.

	Urban students	Rural students
Mean score	62.84	53.46

Table 4 above revealed that students in the urban schools performed better than the students in rural schools. The reasons could be that urban schools had more qualified staff, laboratory facilities etc than the rural schools.

H01. There is no significant difference in the mean achievement scores of students taught through integrating theory with practical and their counterparts taught biology without theory integrated with practical.

Table 5: T-test of difference between the post mean scores of experimental and control groups.

Group	N	Post-test mean of expt. and Control groups	Standard deviation	Df	t.cal	t-table
Expt. Group	20	72.60	10.62	38	5.77	1.684
Control group	20	53.85	9.89			

The result of the analysis shown on table 5 reveals that the calculated t-value of 5.77 is greater than the t-table value of 1.684. This means that there is a significant difference between students taught biology through integrating theory with practical.

H02. The location of the school will have no influence in the achievement score of students taught biology through integrating theory with practical.

H03. There will be no significant difference in the mean achievement score of boys and girls taught biology through integrating theory with practical.

Table 6: Summary of the analysis of covariance (ANCOVA) for comparing data obtained from urban and rural school, and boys and girls on integrating theory with practical in biology.

Sources of variation	Sum of squares	Df	Mean squares	f.cal	f-crit.	Remark
Method	23.22	16	7.74	7.27	3.10	Ho Rejected
Location	25.17	13	8.26	6.34	4.29	Ho Rejected
Sex	20.45	12	6.30	3.68	2.23	Ho. Rejected
Method & location	45.42	17	14.56	5.96	3.67	
Residual	23.42	16	5.74			
Total	135.89	82				

From the above result, it showed that t-calculated values at 0.05 level of significance are greater than the critical values, therefore the null hypothesis is rejected. Therefore, there is a significant difference in the mean achievement scores of urban and rural students and between boys and girls when biology is taught through integrating theory with practical.

Result and discussion

The result of research question one revealed that integrating theory with practical in biology had a high positive effect on students' performance. The high mean score in the post-test result of the experimental group was because the students participated meaningfully well, and were actively involved in the lesson. Because the students were simultaneously taught the concepts and skills while performing practical activities, their performance was found to be better than their counterparts taught biology without integrating theory with practical. The findings of this study support earlier findings of Escalade and Zollman (1996) and Mercy (1997) that practical experiences that utilize hands-on inquiry have been considered as one of the most effective methods of learning science.

In research question two, the result on greater effect shows that boys performed better than the girls when biology was taught through integrating theory with practical. This finding may be attributed to the higher chances of participation of boys in the lesson than the girls. The

result supports the finding of Anyaeze (1996) which identified some factors that contributed to differential valuation of the male and female as due to peer- group, parental, society and culture.

The findings in respect of hypothesis three (H03) tables 6, shows that a significant difference exist in the performance of boys and girls when theory was integrated with practical in biology. The findings of this study agreed with Onyegegbu (2004) that there was a clear disparity between participation lesson in interaction of gender in senior secondary school science. It was found that boys had higher chances of participation than the girls. The boys were more active and dominating in the lesson than the girls.

Result in table 4 shows that students in urban schools performed better than their counterparts in rural schools when theory was integrated with practical. The mean achievement scores of students in urban schools was found to be higher than the mean score of students in rural; schools. This observation could be as a result of availability of adequate qualified staff and facilities which were found more in urban schools than in rural schools. The result of this study agrees with the findings of Ndu (1991), Obodo and Onoh (2001) that some of the problems of teaching and learning science in the rural environments are inadequate of science laboratories, equipment, insufficient number of science teachers, inadequate facilities for students to study science and lack of electricity.

Recommendations & conclusion

The following recommendations have been proffered based on the findings of the study.

1. Practical activities in biology should not be separated from theory lessons so as to help the students related the concepts learnt with the skills for better understanding. The teachers can do this by teaching the concepts and skills simultaneously in order to yield better results in students' achievement.
2. School laboratories, materials and equipment should be provided and made functional in order to enable the staff and students be actively involved in biology lesson when theory is integrated with practical. Government and non-governmental organizations (NGO's) can do this by showing more commitment and political will in making science education functional for scientific and

technological breakthrough.

3. Efforts should be made by the teachers and the school authority to raise the creativity of the learner by encouraging creativity and inventiveness. This can be achieved by providing the opportunity for the students to be actively involved in the lesson and manipulate objects with their hands.

From the findings of this study it was observed that significant differences existed between the mean achievement score of students taught biology through integrating theory with practical and their counterparts taught biology without theory integrated with practical. Similarly, significant differences existed between the mean achievement score of students taught biology through integrating theory with practical in urban and rural schools and between boys and girls. Results from this study showed that the mean achievement score of students increased when biology was taught through integrating theory with practical. The students understood the lesson better, learnt the necessary process skills and concepts and could apply the knowledge learnt in solving everyday problems.

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