

Effects of Field Studies on Learning Outcome in Biology

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KEYWORDS Process. Habitat. Natural. Aquatic. Terrestrial. Environment

ABSTRACT The major purpose of this study was to determine the effects of field experiences on students' knowledge of process of science and biology achievement. The design of the study was experimental, 2 x 2, pre-test, post-test control group design. The sample of the study consisted of 100 biology students in two intact classes. Four research questions were raised and collapsed to four hypotheses. The first three hypotheses were tested with t-test statistic at 0.05 level of significance. The fourth hypothesis was tested with Pearson Product Moment Correlation Statistic. The major findings of this study included: a significance difference in process of science scores between pre-test and post-test of field trip students; a significant difference in process of science test scores between students exposed to field trip experiences and those who were not exposed; a significant difference in biology achievement test scores between students exposed to field trip experiences and those who were not; and a strong correlation between process of science score and biology achievement score. It was concluded that field trip experiences enhanced students' understanding of process of science, improved students' attitude towards biology and significantly influenced their biology achievement.

INTRODUCTION

Background of the Problem

Science is a particular way of investigating the world, and of forming general rules about why things happen by observing particular situations (Raren and Johnson 1996; Johnson and Raren 1998; Mader 2000; Ajaja 2007). A scientist is someone who looks at the world in order to understand how it works. A scientist determines principles from observations (Mader 2000).

The process of science is unique. Science is a human endeavour that considers only what is observable by the senses or by instruments that extend the ability of the senses. A scientific investigation entails a series of steps called "The scientific method" (Mader 2000). Scientists design their experiments with a pretty good idea of the outcome. A scientist integrates all that he or she knows and allows his or her imagination full play in an attempt to get a sense of what might be true.

Although there is no single scientific method, all scientific investigations can be said to have six stages:

1. Collecting observations;
2. Forming hypothesis;

3. Making predictions;
4. Verifying predictions;
5. Performing control experiments; and
6. Forming theory.

The biological science investigation can be done through two main ways:

- a. through practical work; and
- b. through field trips.

Field trip is an outdoor or field work or learning exercise undertaken by teachers and students in certain aspects of subjects particularly, biology so as to give the students the opportunity to acquire knowledge. Krepel and Diwall (1981) defined field trip as a trip arranged by the school and undertaken for educational purpose in which the students go to places where materials for instruction may be observed and studied directly in their functional setting. The use of the term 'field trip' emphasizes some of the formal exercises, which are done outside the classroom usually in biology and geography at secondary and tertiary levels.

The review of relevant literature on the topic, revealed an outline of reasons why biology teachers conduct field trips. Particularly, the works of Orion and Hoystein (1994); Michie (1998) indicated the following purposes as the driving forces for conducting field trips:

- i. providing first hand experience;
- ii. stimulating interest and motivation in science;
- iii. giving meaning to learning and inter-relationship;
- iv. observation and perception skills; and
- v. personal social development.

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All these culminate in influencing student's attitude in the following ways:

- a. interest in hands-on real world experiences;
- b. positive attitude towards the subject;
- c. improvement of the socialization between students, and development of rapport between teachers and students; and
- d. urging teachers to utilize other teaching strategies such as cooperative learning.

Orion (1993) offered a three-part model that can be used for integrating field trips into the curriculum. The three parts include: preparatory, field trip and summary. Each part serves as a bridge to the next part of the model. The first part, the preparatory unit uses concrete learning activities to prepare students for the field trip. This exposes students to materials and equipment that will be used during field trip. The second part is the field trip which is the central part of the model. It serves as a concrete bridge towards more abstract learning levels. It adds in the concretization necessary for higher levels of cognitive learning following the field trip. The third part is the summary unit. This includes more complex and abstract concepts aimed towards the application and transfer of field trip learning. This model indicated a significant improvement in all aspects of learning from the typical stand-alone field trip. By including pre and post-trip elements, the teachers become involved in the instruction of the field trip concepts and connecting them to other topics in the curriculum. Field trip influences learning most when they are related to classroom activities.

Researches in the area have shown that there is less transfer of learning and less meaning when a field trip is not related to classroom teaching. It is strongly recommended that fieldtrips should be integrated into the broader instructional programme and be used only when they are the most effective and efficient procedures for fulfilling learning and curriculum objectives.

Researches in the field also indicate that the relative novelty or familiarity of the field trip setting affects learning. For example, Falk and Balling (1980) noted that settings that are too familiar cause boredom, fatigue and diversionary activities, while settings that are too novel cause fear and nervousness. They maintained that learning is maximized when the field trip setting is of moderate novelty. It is a common experience to find that the more familiar students are with a field site, the more likely they would make good

observations, and collect pertinent data. This is because they know the niches and locations of organisms in the habitat as biology students.

Field trips failure and their rarely being used in biology teaching is due to many factors. These factors include: lack of resource people for assistance; failure of schools to take trip risk; and lack of pre-service preparation in the needed skills, methodology, planning and evaluation of student learning in the field.

This study, which grew out of the observation of less frequency in the use of natural settings as an extension of the biology laboratory for student-initiated, independent and cooperative investigation and the feeling that since it is a hands-on activity, is tailored to find out how field trip affects biology students' learning of methodology of science and biology achievement. Since the biology curriculum in use emphasized empirical processes in science, it seemed appropriate to determine the effects of field exposure on secondary school students acquisition of skills in scientific methods and achievement. The scientific processes that were examined include; observation, classification, experimentation, measurement, communication, counting numbers, inference, prediction, formulating hypothesis, manipulating instruments, understanding space/time relationships, recording, controlling variables, interpreting data, formulating mental models, raising questions, making operational definitions and making conclusions. The contents that were covered included Aquatic and Terrestrial habitats. In specific terms, the purpose of this study was to determine if students' exposure to field trips will influence their knowledge of processes of science and achievement in biology.

Statement of the Problem

Majority of the biology field trips are designed to show particular places and process and are thus expository in nature. Less frequently, the natural settings are used as extension of the biology laboratory for student's investigation. Rarer still has been an evaluation of the effects of field trip on students learning of processes of science. In Nigeria, there are no studies to my knowledge, which investigated the effects of field trips on students learning of processes of science. Since the biology curriculum in use emphasized discovery learning, this study is most appropriate and timely. The problem of the study therefore is,

will the evaluation of skills in processes of science and biology achievement of students exposed to field trip, generate data that will make it an appropriate strategy for teaching and learning biology?

Research Questions

To guide this study, the following research questions were asked.

1. Is there any difference in processes of science test scores of students before and after exposure to a field experience?
2. Is there any difference in processes of science test scores between students exposed to field study and those who were not?
3. Is there any difference in overall biology achievement between students exposed to field study and those who were not?
4. Is there any relationship between process of science test score and biology achievement score?

Research Hypothesis

To properly focus this study, the following research hypothesis were raised and tested at 0.05 level of significance.

H_{01} : There is no significant difference in processes of science test scores of biology students before and after exposure to field experience.

H_{02} : There is no significant difference in post processes of science test scores between students exposed to field experience and those who were not.

H_{03} : There is no significant difference in overall biology achievement between students exposed to field experience and those who were not.

H_{04} : There is no relationship between students' processes of science test scores and their scores in biology achievement.

METHODOLOGY

Design of the Study

The study employed a 2x2 pre-test post-test control group experimental design. This design consisted of two instructional groups (field trip group and formal classroom teaching group) and

repeated testing (pre-test and post-test). The main independent variable was exposure to field trip, while the dependent variables were performances in processes of science and achievement in biology.

Population and Sample of the Study

The test population consisted of 220 senior secondary class two (SSII) students in St. Charles College, Abavo. From the population of 220 SSII students, a sample of 100 students in two intact class were selected. The sampled subjects consisted of 50 students in each class. One class formed the field trips class while the remaining one served as the control group where classroom teaching method was used.

Two experienced teachers were assigned to teach the experimental and control groups. The two teachers selected to teach the subjects have been teaching biology in the secondary school for the past eight years and are both graduates of biology education.

Instruments

Instructional Materials: The instructional material consisted of a six-week teaching unit. The content of instructional programme covered consisted of contents on Aquatic and Terrestrial habitats. The major reference biology books were Modern Biology by Ramalingan (2005) and Inquiry into Life by Mader (2000).

Test Materials: The test instruments used for the study included: Process of Science Test (PST) and Biology Achievement Test (BAT). The Process of Science Test (PST) consisted of 50 multiple choice test questions in biology testing students' knowledge of Process of Science. The Biology Achievement Test also consisted of 50 multiple choice test questions testing students' knowledge of concepts in the six-week teaching unit on Aquatic and Terrestrial habitats.

The Processes of Science Test (PST) and Biology Achievement Test (BAT) were not standardized tests and so were validated to determine if they were suitable for the study. The two test instruments were validated by a jury of three experienced senior secondary school certificate examination examiners in biology and an expert in Measurement and Evaluation. Since content validity was what was determined, the choice of a jury and its composition was accurate

and agrees with the recommendations of Wiseman (1999) and Johnson and Christensen (2000). The reliabilities of the two test instruments were determined by using test-retest strategy. The values obtained indicated that PST has a reliability value of 0.79 while BAT has a reliability value of 0.79. These agreed with the recommended standard, that as a rule, a high reliability of 0.70 or higher shows that a test is reliable (accurately) measuring the characteristics it was designed to measure (Wiseman 1999; Johnson and Christensen 2000; Borich 2004).

Planning for the Field Trips

In planning for the field trip, the trained by the researcher teacher did the following:

- i) Planned objectives for the field trip. This he did with the students.
- ii) Explained to the students where they were going, why they are going and what they are expected to observe.
- iii) Visited the field trip location and obtained copies of any available descriptive materials.
- iv) Discussed the field trip with the principal and obtained approval.
- v) Was acquainted with the place to be visited. He did this by visiting the place, interacting with people there and obtaining a date and time for the trip well in advance.
- vi) Obtained permission from parents and guardians of the students and also any other teacher whose periods are to be taken up by the field trip. The guardians and parents were informed of the field trip objectives, travel details and finances.
- vii) Planned for transportation, time schedule, finances and others.
- viii) Prepared with the students questions that will be asked. Also areas of interest of teacher and students to be visited.
- ix) Shared out responsibilities for documenting the field trip (examples include: photographing, sketching, and tape recordings).
- x) Defined safety and behaviour standards and also planned for appropriate clothing for trip condition.
- xi) Planned for feeding and accommodation and unexpected illness or other emergencies (This necessitated carrying first aid kit).

Treatment Procedure

The two instructional groups compared: field trip (experimental) and formal classroom teaching (control) groups were identified on a result of teacher initiated activities during and after classroom exercises. The effects of field trips on students learning the methodology of science and biology achievement of 100 biology students in Senior Secondary school classes two (SS II) was investigated in the controlled conditions of field experiences. All the subjects were pre-tested before treatment.

The materials learned by the subjects from where the tests on processes of science and achievement in biology were drawn, were contained in a six -week instructional unit drawn from Aquatic and Terrestrial habitats in the National Curriculum for Science. The selected biology teachers to teach the experimental and control groups were trained on the basic skills of field trips before the commencement of treatment. During the treatment period, students in the field trip group were instructed by the teacher who followed the guidelines learned during the training by the researcher. The teacher in the field trip group incorporated the basic elements of field trip learning into the groups' experiences. Every ecosystem taught was accompanied with a field trip. During the field trip, students were divided into groups of five each and given specific instructions on what data to collect from the environment. They were also to analyze the data collected and draw inferences from them. The teacher explained tasks to be carried out and assigned roles within the groups.

In the group taught with the formal classroom teaching method, they were taught the same content in Aquatic and Terrestrial habitats by the teacher. The teaching unlike that aided with field trips, was text-book centered. Instead of accompanying every topic taught with a field trip, to illustrate situations in natural settings, students read the assigned reading materials silently, completed assignments independently in their seats, engaged in discussions with the teacher in response to teacher's questions. The teacher teaching this group dispensed facts to the students without illustrating the facts with field experiences. At the end of every week's instruction, Post Processes of science and biology achievement tests were administered to both the experimental and control groups. At the end of the sixth week of instruction, processes of science and biology achievement tests scores of the

subjects in the experimental and control groups were averaged to arrive at the individual student's Post-test scores.

RESULTS

Shown in table 1, there is a significant difference between the Pre and Post-test scores of students exposed to field trip experiences on Processes of Science ($t=10.594$, $P<0.05$). With this result, H_{o1} was therefore rejected.

Table 2 shows that there is a significant difference between students exposed to field trip experiences and those who were not on Processes of Science scores ($t=7.058$, $P<0.05$). With this finding, H_{o2} was therefore rejected.

Table 3 shows that there is a significant difference in biology achievement between students exposed to field trip experiences and those who were not ($t=8.594$, $P<0.05$). With this finding, H_{o3} was therefore rejected.

Shown in table 4, there is a strong correlation between Process of Science score and biology achievement score ($r = 0.66$). As a rule, using Pearson Product Moment Correlation to determine

correlation, any calculated r value from 0.5 to 1 is regarded as a strong correlation. With this result, H_{o4} was therefore rejected.

DISCUSSION

This study is very significant in the sense that it has been able to demonstrate the usefulness of fieldtrips in the learning of biology. The study has shown the cognitive, psychomotor and affective outcomes of fieldtrips. The analysis of these outcomes have demonstrated that there are positive cognitive, psychomotor, and affective (interpersonal and behavioural impacts of field trips by students agreeing to work together) influences of field trips on students. Interviews of teachers and students engaged in fieldtrips have produced responses that suggest that there is increased cooperation between pupils with new friendships established, improved relation with teachers, increase in knowledge and skill base, and most significantly, those students who often demonstrate challenging behaviour have improved attention and participation back in the classroom.

Table 1: Summary of t-test analysis comparing the pre-test and post-test scores of field trip group on process of science

	<i>N</i>	<i>Mean</i>	<i>SD</i>	<i>t-cal value</i>	<i>P</i>
Pre-test	50	22.50	1.82	10.594	0.05
Post-test	50	53.50	7.6459		
Difference		+21.00			

Table 2: Summary of t-test analysis comparing the post-test process of science score of field trip group and formal classroom teaching method group

	<i>N</i>	<i>Mean</i>	<i>SD</i>	<i>t-cal value</i>	<i>P</i>
Field trip group	50	53.50	7.6459	7.058	0.05
Formal classroom group	50	44.2800	4.7597		
Difference		+9.22			

Table 3: Summary of t-test analysis comparing the post-test biology achievement score of field trip group and formal classroom teaching method group

	<i>N</i>	<i>Mean</i>	<i>SD</i>	<i>t-cal value</i>	<i>P</i>
Field trip group	50	53.3600	5.7348	8.594	0.05
Formal classroom group	50	50.0800	3.5905		
Difference		+7.2800			

Table 4: Summary of correlation between process science score and biology achievement score.

	<i>N</i>	<i>Mean</i>	<i>SD</i>	<i>t-cal value</i>	<i>P</i>
Process of science score	50	50.50	7.6459	0.66	0.05
Biology achievement score	50	57.36	5.7348		

The most important usefulness of field trips lies in the basic fact that they provide the most realistic means for meeting organisms in their actual environments. This enables students gain first hand information, and provide opportunities for them to see and possibly touch and feel what they have heard and read about them. Field trips afford the students the opportunity of employing various senses in the process of learning biology as a science. This makes topics or concepts and principles taught more vivid and retention better.

On the finding of significant difference in process of science test scores between the pre and post tests, it tends to suggest that the improvement in test scores between the pre and post tests was not by chance but as a result of the field trip experiences other intervening variables notwithstanding. This finding properly falls in line with the position of Ausubel (1968) discussed by Ajaja (1998) that the simple most important determinant of students learning is previous experience which field trips offer. The significant difference found between students exposed to field trip experiences and those who were not on process of science test suggests that the field trip treatment which emphasized practical collection and analysis of data by students may have greatly influenced their acquisition of skills in the process of science. This development, a product of discovery teaching, agreed with Brunner (1965) finding that discovering teaching enhanced critical thinking and influenced students retention. What you discover, you hardly forget. This again, is in line with Ajaja's (1998) findings and Ajaja and Kpangban's (2004) recommendation that discovering teaching should be adopted as the most effective method for teaching science because of its influence on retention.

Other findings of this study also indicated that students exposed to field trip experiences performed significantly better in post biology achievement test than those who were not and that students process of science test scores influenced their achievement in biology. Taken together, the findings tend to suggest that field experiences may have greatly influenced students' understanding of the concepts taught in the class. Mader (2000) and Ajaja (2007) maintained that the scientists look at the world in order to determine how it works and determines principles from observation as done in field trip. The field trip experiences have not only changed the students' understanding of the process of

science their understanding and knowledge of biology has equally changed.

As shown by the findings, the experimental groups showed gains in all the post tests. It is most interesting to note that all of the gains registered were not the result of any formal instruction in science which of course was not done. The only instruction given was the directives to group leaders and others on the data collecting process due to the absorption of the students in an atmosphere where the common interest was scientific investigation for at least 7 hours per day, for six different trips. It is probably fair to conclude that the field trip experience has shown to be a highly effective educational model in the area of scientific methodology and achievement.

CONCLUSION

It would be quite easy to overextend the implications of these results for biology teaching and learning. Experimental constraints posed by the nature of the situation require cautious interpretation. Even with that limitation, biology teachers generally believe that field trip activities enhance students understanding of the processes involved in science, and also improved student's attitude towards science and biology in particular. This therefore suggests that field trips should be integrated into the teaching programme. This will enable students gain first hand information, and provide opportunity for them to see, possibly touch and feel what they have heard about certain organisms and situations.

RECOMMENDATIONS

Based on the findings of the study, the following recommendations are made:

Firstly, field trip experiences should be part of the experiences in biology curriculum which students should be exposed to.

Secondly, field trip experiences when used should be relevant to contents in the curriculum if they are to make the necessary impact.

Thirdly, field trip experiences should emphasize real practical experiences with the students collecting, analyzing data, interpreting data and using them to explain previous knowledge.

Finally, for the exercise to be successful, it

has to be well-funded by both the school authorities and parents.

NOTES

1. *Process of Science*: These are all the activities Scientists engage in during investigation.
2. *Formal Classroom Teaching Method*: This is the type of teaching method where content materials are presented to the learner's in their final forms.
3. *Natural Environment*: Where organizations are naturally located.

ABBREVIATIONS

1. PST: Process of Science Test
2. BAT: Biology Achievement Test
3. SS II: Senior Secondary School Class II

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