

## **PROMOTING GENDER EQUITY IN STUDENTS' ACADEMIC ACHIEVEMENT IN ECOLOGICAL CONCEPTS USING THE OUTDOOR LABORATORY METHOD**

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### **Abstract**

*The study was on how gender equity in students' academic achievement in ecological concepts could be promoted in a depressed economy using the outdoor laboratory method of teaching. The population of the study comprised 1360 senior secondary two school students in one urban school and one rural school in Bauchi central and Katagum education zones. One hundred and thirty six students constituted the study sample selected from an urban and a rural school. The study employed then on randomized pre-test post-test non-equivalent control group design. An Ecological Concepts Achievement Test (ECAT) was for data collection from the students. The reliability index of the ECAT was determined as 0.99 using the Cronbach alpha method. Two research questions and three hypotheses guided the study. The research questions were answered using mean and standard deviation while the hypotheses were tested using t-test statistics at  $p \leq 0.05$  level of significance. Findings from the study showed no significant difference between the mean ecological concept achievement scores of male and female students taught ecological concepts using the outdoor laboratory method. Furthermore, there was no significant difference between the mean ecological concept achievement scores of male and female students in urban and rural schools taught using the outdoor laboratory method. It was concluded that gender equity in students' academic achievement in ecological concepts can be achieved by employing the outdoor laboratory method. It was recommended*

*among others that teachers should incorporate the outdoor laboratory method for effective science education delivery this period of depressed economy where funds for provision of indoor science laboratory facilities are grossly inadequate*

### **Introduction**

The science and technology education sector as well as the other sectors of economy in Nigeria are facing a lot of challenges as a result of the prevailing economic depression in the country. This is not a good omen considering the significant role science and technology plays in the development of any nation. In recognition of the importance of science and technology in economic growth, the Nigerian government in its national policy on education (Federal Republic of Nigeria [FRN], 2013) emphasizes the teaching of science and technology courses at the different levels of education in the country. At the senior secondary school level for instance, biology is one of the core science courses students who specialize in science subjects are taught. Ecology which is an aspect of biology is the scientific study of knowledge concerned with the economy of nature. It is one of the branches of biology that deals with the study of interrelationships among plants, animals and their non-living environment (Nwagbo & Obiekwe, 2010). The utility of ecological concepts in day to day life and activities of humans has made ecology as an important aspect in biology education.

In citing Ige (2001), Nwagbo and Obiekwe (2010), posit that ecology provides knowledge and understanding of the mechanisms of change brought about by interaction of the living things and their effects on their external environment. Ecology gives the students an opportunity to meet with some of the most ecological issues affecting their environment. These include the influence of human activities in altering human ecological relationship and the difficulties arising from the problems of modern day life (Nwagbo & Obiekwe, 2010). The continual increase of human population and the associated destruction of natural environments with deforestation, pesticides and pollutants have awakened the awareness of the public to the world of ecology (Verma & Agarwal, 2010).

The Nigerian government in a bid to promote the teaching and learning of science and technology courses, has made a lot of efforts, such as mandating the Joint Admissions and Matriculation Board to offer admissions to students in the ratio of 60:40 and 80:20 respectively, in favour of science and technology courses in conventional and technology-based universities. Other efforts include the provisions of science facilities, training of science and technology teachers in technical aid programmes, implementation of the

Science and Technology Education Post Basic (STEP-B) Project and the review of the secondary school biology curriculum with the inclusion of important environmental issues that affect humans, and the environment.

Despite the relevance of ecology to day to day life activities of humans and sustainable environment/development, literature is replete with evidences of poor achievement of male and female students in biology in general and ecological concepts in particular, in public examinations, such as the West African Examinations Council (WAEC) and the National Examinations Council (NECO). Statistics of biology achievement in May/June West African Senior Secondary School Certificate Examinations (WASSCE) from 2010 to 2016 revealed poor achievement outcomes in this important subject (Nwagbo & Obiekwe, 2010).

A number of factors have been identified as contributing to the poor achievement outcomes. One of such factors is the teacher's method of teaching. Research reports (Nwagbo, 1999; Ozoji, 2010) indicate that many science teachers prefer the traditional expository method of teaching ecological concepts and shy away from innovative and activity activity-oriented teaching methods, such as, the outdoor laboratory approach. Effective teaching and learning of ecology in Nigerian schools is bedevilled by a lot of other problems. For instance, teachers and students respectively, find it difficult to teach and learn ecology concepts. This is in line with the view of Ige (2001) who opines that many ecological topics are complex and difficult to present. This may be why Otuka (1987) in Waziri (2011) suggests that students must be helped to acquire the fundamental principles and the key concepts of ecology. In Nigerian schools experience shows that teaching of ecology is done in secondary schools most of the time without the use of real specimens, physical models and other relevant instructional materials. This brings about hindrances in the effective teaching and learning of ecological concepts which are perceived as abstract and difficult. Again even where the materials were provided, teachers either seldom use them or lack the required skills for their proper utilization (Madu, 2003). Ema (1997) asserts that instructional materials provide the true picture of the objects and concepts taught in science classrooms. They help to widen the intellectual experience of the students, provide students with values that are inaccessible to them. Brunner (1983) in Otuka & Uzoечи (2009) suggest that teachers should work as models, communicators, and identification figures supported by a wise use of materials or variety of devices in order to expand experience, clarify it and give significant meaning to it.

In ecology, concepts such as biosphere, atmosphere, Biome. ecosystem, niche, biomass, carrying capacity, turbidity, ecological succession,

appear abstract and students can only meaningfully learn the concepts using the outdoor laboratory approach. Many concepts depend on other sub-concepts for the explanation and full understanding of their meanings. Lack of relevant instructional materials is a major constraint to effective teaching and learning of ecological concepts (Madu, 2003). Moreover, there are ecological concepts that cannot be taught within the four walls of a conventional indoor science laboratory. Madu lamented that teaching methods used by teachers particularly the verbal and non-verbal behaviours in classrooms have significant effects on learning of ecology concepts, hence the need for outdoor laboratory approach in teaching and learning of ecological concepts.

The government has in this regard provided infrastructure in order to create conducive learning atmosphere, provided some instructional materials, trained teachers through huge investments in the technical aid programme. However, these efforts do not seem to have yielded the desired results. The facilities provided for instance, appear to be grossly inadequate both in quantity and quality. Findings from studies still point to the fact that students are failing abysmally in biology, particularly in the area of ecology.

Outdoor laboratory and places of interest have a significant influence on achievement when judiciously used as presented as follows:-

1. Provide additional support materials to other teaching resources available to the teacher.
2. Add variety of learning through breaking teachers monotony and of lecture method.
3. They generate motivation of instruction among students which encourage permanence of learning.
4. They make students appreciate their social and physical environment and contribute to community wellbeing.
5. Outdoor laboratory helps students develop certain skills, such as observation, listing, collection, classifying, identifying and so forth to obtain firsthand information and knowledge from resource persons and places of visit.
6. Outdoor laboratory strengthens school-community relationship when community resources are used during field trips.
7. They are significant in discovering unknown but useful locally produced materials (FME, 2007).

Gender inequality in science and technology classrooms has been an issue of great concern to educators and researchers over the years but research findings have been inconclusive on it. For instance, Anigbogu and Ezeliora (2007), Orabi (2007) found no significant differences in each case between

male and female students who were taught science concepts. Ajibade (2000) in his study found that female students out-performed their male counterparts in a science achievement test while the finding by Iwendi (2009) showed the opposite. However Udok (2006) and Vale (2009) reported that even though gender differences exist in science and mathematics achievement, it is declining. Among various factors that affect teaching and learning of ecological concepts is differences in gender which invariably limits occupational choice leading to career-barrier for women. This is critical in the sense that girls and women who form a greater size of the Nigerian population may not be able to contribute to the technological development of their country in line with global best practices. Moreover sexual differentiation segregates the roles men and women are supposed to play within the cultural milieu (Anagbogu, 2000).

Moreover, no studies available to the researchers appear to have investigated the issue of employing the outdoor laboratory method to investigate its efficacy or otherwise in promoting gender equity in achievement of students in ecological concepts at the secondary school level of education in Nigeria and Bauchi State in particular. It is against this backdrop that the researchers embarked upon this study.

The following research questions and hypotheses guided the study:

1. What are the mean scores of male and female students taught using the outdoor laboratory method in Ecology Achievement Test?
2. What are the mean scores of male and female students in urban and rural schools taught using the outdoor laboratory method in Ecology Achievement Test?
  1. There is no significant difference between mean achievement test scores of male and female students taught with outdoor laboratory method in ecology.
  2. There is no significant difference between the mean achievement test scores of male and female students taught with the outdoor laboratory method in urban schools.
  3. There is no significant difference between the mean achievement test scores of male and female students taught using the outdoor laboratory method in rural schools.

The hypotheses were tested at 0.05 level of significance

## **Method**

The non-randomized pre-test post-test non-equivalent control group design was employed in the study. The population of the study comprised

1360 senior secondary two school students in urban and rural schools in Bauchi central and Katagum education zones. One hundred and thirty six students constituted the study sample obtained from an urban and a rural school in the area of the study. The urban and rural schools were selected from their stated education zones using the simple random sampling technique. Two intact classes were used in the rural and urban schools respectively. In each of the schools, one intact class was used as the experimental group while the other was used as the control group. An Ecological Concepts Achievement Test (ECAT) was used to collect data from the students. The ECAT test items were adapted by the researchers from the West African Examination Council and National Examination Council (WAEC/NECO) past examinations question papers in biology. The ECAT consisted of 25 multiple choice questions and was content validated by two experts in science education and a lecturer in tests and measurement from the Faculty of Education, University of Jos. The aim was to ascertain the suitability of the instrument. The inputs by the experts were used to obtain the final version of the ECAT. The reliability index of the ECAT was established as 0.99 using the Cronbach alpha method. Two research questions and two hypotheses guided the study. The research questions were answered using mean and standard deviation while the hypotheses were tested using t-test statistic at 0.05 level of significance.

A pre-test on ECAT was administered to the experimental and control groups before their exposure to different conditions of teaching by two biology teachers who were used as research assistants in each of the schools used for the study. The experimental and control groups in Bauchi central were taught by one of the researchers and a research assistant, respectively while in Katagum the experimental group was taught by a researcher assistant trained for one week on the use of the outdoor laboratory method while the control group was taught by the second research assistant using the lecture method. The teaching exercise lasted for four weeks and was followed up by a post-test administered to the experimental and control groups. The same lesson notes prepared by the researchers were used to teach the experimental and control groups except that for the experimental group, the outdoor laboratory method of teaching was incorporated in addition. At the end of the administration of the instruments for pre-test and post-test, students' answer scripts were collected and scored by the researchers. After scoring, the scores were collated and set aside for analysis.

The research questions were answered using mean and standard deviation while the hypotheses were tested for significance at 0.05 level using t-test statistic.

**Results**

Table 1: Means Scores of Male and Female Students taught with Outdoor Laboratory Method

Gender	Mean	SD
Male	64.98	14.86
Female	59.66	12.39

The data presented in Table 2 indicate that the mean achievement scores of male students is 64.98 in ECAT while that of female students is 59.96 in the experimental group.

Table 2: Means Scores of Male and Female Students taught using Outdoor Laboratory Method in the Urban Schools

Gender	Mean	SD
Male	66.24	13.19
Female	59.32	14.04

Results in Table 2 show that the mean scores of male and female students in the urban schools are 66.24 and 59.32, respectively.

Table 3: Summary of t-test Analysis of mean Achievement Scores of Male and Female Students taught with outdoor Laboratory Method.

Method	Mean	SD	t-cal	t-critical	Df
Male	64.98	14.86	1.31	2.01	48
Female	59.91	12.36			

The results in Table 3 show that the calculated value of t (1.31) is less than the critical value of t (2.01) showing that there was no significant difference between the mean achievement test scores of male and female students taught using the outdoor laboratory method. The hypothesis was therefore retained.

**Table 4:** Summary of t-test Analysis of Mean Achievement Scores of Male and Female Students taught using Outdoor Laboratory Method in Urban Schools.

Gender	X	SD	t-cal	t-crit	df
Male	66.24	13.19	1.80	2.01	48
Female	59.32	14.04			

The results in Table 5 show that there was no significant difference between the mean achievement scores of male and female students exposed to the outdoor laboratory method. The t-calculated (1.31) is less than the t-critical (2.01). Therefore, gender was not a significant factor in students' achievement. The hypotheses was therefore retained.

**Table 5:** t-test of Performance Mean Scores of students taught with outdoor laboratory method in Rural Schools.

Gender	Mean	SD	t-cal	t-crit	Df
Male	62.24	12.90	1.70	2.01	48
Female	56.32	13.31			

The findings in Table 5 show that mean achievement scores of male and female students taught with the outdoor laboratory method in rural schools did not differ significantly since the t-calculated value of 1.70 at 0.05 level of significance is less than the table value of 2.01.

## Discussion

The study investigated the use of the outdoor laboratory approach in promoting the achievement of male and female students' in ecological concepts in a depressed economy. Results from Table 3 showed that the difference in the mean scores of the students were not statistically significant. This result is in compliance with findings of previous researchers (Aworanti & Abimbola, 1997; Abonyi, 1998) which indicated that there was no significant difference between the performance mean scores of males and females in the biology performance test. The result of no significant difference in terms of gender could be as a result of outdoor biology laboratory approach employed in teaching the male and female students. This is in consonance with the recommendation of Aiyedun, (2000) that difference in science achievement of male and female students could be taken care of using good methods, materials and appropriate teaching strategies. The results further agrees with the observation by Nwogu (2004)

that exposing students to appropriate learning environments and activities reduces gender gap in science achievement. This will help ameliorate the problem of unavailability of resources and other instructional aids in the secondary schools in Nigeria, particularly in the present period of depressed economy in the country where there are insufficient funds to equip science laboratories adequately by the government for effective teaching and meaningful learning of science concepts and principles by students in line with best practices globally.

The results on Tables 4 and 5 show that the mean achievement scores of students taught with outdoor laboratory method in urban and rural schools did not differ significantly. This result is in agreement with the findings of previous researches (Fakunle, 1986; Aworanti & Abimbola, 1997; & Bello, 2011) which indicated that school location had no significant influence on the performance of students in ecological concepts test. This therefore, means that students in rural schools can experience ecological concepts and principles, and, at the same time do well in ecological achievement test as their counterparts in urban schools.

### **Conclusion**

In conclusion, gender equity in students' achievement in ecological concepts can be promoted and achieved by using the outdoor laboratory approach. By using the outdoor laboratory approach many locally available resources/ instructional materials are used to promote meaningful learning in the place of expensive and unaffordable instructional resources imported from other countries.

### **Recommendations**

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

1. Biology teachers should be creative, resourceful and enthusiastic through incorporating outdoor biology laboratory approach as one of the methods of teaching biology/ecology, with the view of promoting gender equity in achievement in ecological concepts in Nigeria, particularly with the present economic depression in the country where funds for provision of indoor science laboratory facilities are grossly inadequate.
2. Curriculum planners and science educators should modify the biology curriculum and incorporate the use of outdoor laboratory approach and other innovative and activity-based strategies for effective teaching and learning in senior secondary schools and all teacher education

institutions. Textbooks should be written to illustrate more on the application of outdoor laboratory approach on different content areas on biology, specifically on ecological concepts and principles.

3. The ministry of education in each state of the federation, particularly, Bauchi State and school administrators in senior secondary schools should provide adequate and relevant outdoor centres and activities available in their-communities such as botanical gardens, zoos and museums where the teachers and students can use as outdoor laboratories for ecological studies.
4. The ministry of education through the inspectorate division should ensure that, the methods of instruction emphasize the outdoor laboratory technique. This will motivate teachers and students and also create interest in students in learning ecological concepts. The different tiers of governments should utilize the services of various professional bodies, such as, the Science Teachers Association of Nigeria (STAN), Nigerian Union of Teachers (NUT) and All Nigeria Conference of Principals of Secondary Schools (ANCOPSS), faculties/institutes of educations in the Universities to organize seminars, workshops and conferences for science teachers on the use of active learning strategies such as the outdoor laboratory method to promote gender equity in science.

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