

Effect of Learning outside the Classroom on Students' Academic Achievement in Chemistry in Secondary Schools in Port-Harcourt Metropolis.

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Abstract

The study was carried out to ascertain the effect of learning chemistry outside the classroom on students' academic achievement in secondary schools in Port Harcourt. The study was guided by three objectives, three research questions and two hypotheses. Two research designs were used which include: descriptive survey design and quasi-experimental design. The sample for the study was 259 students and teachers comprising 14 teachers and 245 students purposively selected. Two instruments were used for data collection. These were a structured questionnaire titled, "Learning Outside the Classroom in Chemistry Questionnaire." And a Chemistry Achievement Test. The instrument was validated by three experts and with a reliability coefficient of 0.79 obtained using test retest method for the chemistry achievement. A total of 259 copies of the instrument were distributed to the research participants and a total of 235 were retrieved and used for data analysis. Frequency, counts, percentages and Mean were used to answer the research questions while t-test was used to test the hypotheses at 0.05 level of significance. The result of the study showed that Teachers engaged students in learning outside of the classroom through mediums such as field trips and excursion. The result also showed that learning outside classroom enhanced students' academic achievement. Based on the findings, it was recommended that Students should be exposed to other informal mediums of learning outside classroom such as parents using their work activities related to chemistry and adventure camps. It was also recommended that Seminars and Workshops should be organized to equip teachers with skill and knowledge of how to employ the method for teaching and learning of chemistry and other science subjects.

Keyword: *learning outside the classroom, academic achievement, gender*

INTRODUCTION

Science education plays vital role in technological advancement of a nation. It is believed that countries of the world that have made great development and advancement in technology have done so because of the value attached to science education. For example, the launching of sputnik, the world's first artificial satellite was only possible because of value placed on Physics in science education (Kola, 2013). Science education as studied in school comprises three subjects including Physics, Biology and Chemistry. Students, well grounded in electronic aspect of physics can serve as electronic technicians. Knowledge of semiconductor in Physics could equip students with skills to work in ceramic industry; knowledge of science education is useful in information and communication technology. Knowledge from biology, an aspect of science education is useful in biotechnological development. Chemistry is not left out. Knowledge of chemistry can enable students to make chalk, dye and soap and Chemistry is useful in the field of medicine, petroleum industry. In drug production and manufacturing, knowledge of chemistry is much needed in chemistry (Helmenstine, 2020). Considering the important role that chemistry plays in development, effective teaching and learning of the subject is essential for ensuring knowledge among students.

Learning outside of the classroom also referred to as outdoor or out of class learning is the use of a place beside the usual classroom or laboratory for learning (Department for Education and Skills, DfES, 2006). It is a form of instructional delivery that places students in a learning environment that motivates their learning interest (Sulaiman, Mabob & Azlan, 2011). Typical examples of this form of learning include: field trips, industrial attachment programs and others (Achor, Ogbeba & Amadu, 2014). In such activities, the intention is usually to take students away from the four walls of the classroom and school to a place where they will be exposed to some learning experiences. For example, during field trip, students could be taken to an industry or factory to see may be a manufacturing process during which they are given opportunity to ask questions to clarify any doubt. Maciejowska (2007) suggested possible places outside of the school that learning of specific chemistry topics could be conducted. In the suggestion, a topic such as crystals, crystallization, ionic bond could be learnt at a salt mine. Topic related to natural resources could be conducted at a geology museum. Dissolution,

precipitation reactions, properties of Cl_2 and phenols could be learnt at a water treatment plant. Combustion processes could be learnt at a power station. Learning about gas and dust air pollution could be conducted at an environmental sanitation office. Redox reaction could be learnt at a metallurgical factory. In their study, Adebisi and Asaolu (2020) identified possible learning outside the classroom activities to enhance learning of Basic Science and Technology on the topics: environmental pollution, living/nonliving things, energy, gravitational force, chemicals, change of state, environmental hazards as organizing visit to polluted water site, going on nature walk to collect different samples of matter, provision of materials to illustrate different forms of energy outside classroom, demonstrating the effect of gravitational force outside the classroom, visit to a chemical factory, carrying out activity on boiling/evaporation, visit to an erosion site respectively.

Learning in a less structured outside classroom environment provides a diverse learning experience from that of the classroom; helps students and learners to express themselves; makes learning to be multi-sensor which in turn, enhance knowledge retention (Malone & Tranter, 2010; Phillips, 2015). In addition, Achor, Ogbeba and Amadu (2014) viewed that field trip, a form of learning outside the classroom makes what is learnt in classroom concrete and also helps students connect concepts and experiences.

Achievement means measurable behavior obtained from a standardized series of tests Achievement test is usually constructed and standardized to assess proficiency in school subjects. It is used to describe or measure a students' accomplishment over a period of time in terms of learning. In other words, academic achievement measures the amount of learning, students have attained, achieved or accomplished at the end of a course (Simpson & Weiner as cited in Yusuf, 2002). The present study focuses on the influence of learning outside the classroom on students' academic achievement in chemistry among students.

A number of literature review has shown that learning outside the classroom affect student's academic achievement, for instance; Achor, Ogbeba and Amadu (2014) conducted a study to investigate effect that school outdoor activities could have on senior secondary two students' retention in ecology in Jalingo metropolis of Taraba State. The study adopted a non-randomized pretest posttest control group quasi-experimental design. The sample for the study was 160 students selected from a population of 1,227 from 13 co-educational schools. The instrument for data collection was a 40 item Biology Achievement Test (BAT) developed by the researchers with reliability co-efficient of 0.95 using Kuder-Richardson formula 21 was used for data collection. Mean, standard deviation was used to answer the research questions while analysis of covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance. The result shows that there was a statistically significant difference in the mean retention scores of student taught using outdoor activities and lecture method. There was no statically significant difference between the mean retention scores of boys and girls exposed to school outdoor activities. Similarly, there was no statically significant interaction effect of method of teaching and students' gender and their retention in ecology.

Oyovwi (2020) conducted a study to examine the effects of outdoor science activities on student's academic achievement and retention in science in Delta South Senatorial District. The study adopted a quasi-experimental design. The population consists of all senior secondary school two (SSII) science students in all the Government-owned public schools in the Senatorial District with an estimation of 15,275 students out of which a sample of 250 SSII science student's randomly selected from four (4) public mixed secondary schools in the study area. A Science Achievement Test (SAT) validated and with a reliability coefficient of 0.82. Data were analysed by mean, standard deviation, Analysis of Variance (ANOVA) as well as Analysis of Covariance (ANCOVA). The results showed that there was a significant difference in the mean achievement and retention scores between students taught using outdoor science activities and those taught without outdoor science activities. There was no significant difference in the mean achievement scores between male and female students taught science with outdoor science activities and there was a significant difference in the mean retention scores between male and female students taught science with outdoor science activities in favour of male students.

Awodun and Boris (2020) conducted a study to ascertain the effects of outdoor activities teaching strategy on students' academic achievement in secondary school Basic Science in secondary schools in Ikere Local Government Area, Ekiti State, Nigeria. The study adopted a pretest, posttest, control group quasi-experimental design. The sample for the study constituted 140 public JSS I Basic science students selected through purposive and stratified random sampling techniques from four junior secondary schools in Ikere Local Government Area, Ekiti State. The instrument for data collection was a Basic Science Achievement Test (BSAT) and the treatment package used for the study was tagged: Outdoor Instructional Package (OIP). The data collected were analysed using t-test and ANCOVA statistical analysis packages. The results of the analyses showed that no significant difference existed between the achievements of students in experimental and control groups involved in the study at pretest (this indicated initial academic homogeneity of the groups). However, students' achievement in the experimental group at post-test level was found to be significantly better than that of the control group. This showed that Outdoor teaching strategy significantly influenced students' achievement in Basic Science in Junior Secondary School.

Görkem and Gümüş (2020) carried out a study to find out the effects of outdoor education in social studies teaching on students' academic achievement and knowledge recall. In the study, the study adopted a quasi-experimental design, specifically, the pretest-posttest control group was used. The sample for the study was 64 fourth grade students from public schools in Buca district of İzmir province of Turkey. Data for the study were collected using "Academic Achievement Test" created by the researcher within the scope of the primary school fourth grade level. Data collected were analysed using t-test and two-way analysis of variance. The findings of the study showed that academic success and retention levels of students in the experiment group who took outdoor education activities and outdoor education in social studies were significantly higher than those of the control group students who performed courses according to the curriculum and activities of social studies courses in the classroom environment.

The present study also focuses on the influence of learning outside the classroom on students' academic achievement in chemistry among students.

Statement of problem

Chemistry is a very important aspect of science. It is the study of matter and change (University of Wisconsin, 2021). In fact, chemistry has a wide application in the society. In agriculture, fertilizer is used to enhance plant healthy growth. Fertilizer used for this purpose is made from chemical compounds and elements manufactured through the knowledge of chemistry. Knowledge of chemistry is required in chemical, petroleum and petrochemical industries. Chemistry has wide application in medicine. Production of drugs requires knowledge of the chemistry behind the compounds used for such drug production (Emendu, 2014).

Although, chemistry plays an important role in the development of the society, observation however shows that academic achievement in the subject has been low. This poor achievement in chemistry has been attributed to different factors. Among these factors are usage of inappropriate instructional method and poor usage of instructional materials for instructional delivery (Okey & Omeodu, 2018; Nja, Cornelius-Ukpepi, Edoho & Neji, 2020). Usage of an effective instructional method could contribute to effective learning in chemistry. A number of empirical studies show that usage of outdoor or learning outside the classroom contributes to effective learning among students. The present study therefore seeks to find out the effect of learning outside the classroom on students' academic achievement in chemistry in Port Harcourt metropolis

Purpose of the Study

The purpose of the study is to ascertain the effect of learning chemistry outside the classroom on students' interest and achievement in senior secondary schools in Port Harcourt. Specifically, the study intends to:

- 1 Identify the different environments for learning chemistry outside the classroom in secondary schools in Port Harcourt.
- 2 Determine the difference between the mean achievement scores in chemistry of students exposed to learning outside the classroom and those exposed to lecture instructional methods.
- 3 Determine the difference between the mean achievement scores in chemistry of male and female students exposed to learning outside the classroom instructional method

Research Questions

The study was guided by the following research questions:

1. What are the different learning outside the classroom environment employed for learning chemistry in secondary schools in Port Harcourt?
2. What is the difference between the mean achievement scores in chemistry of students exposed to learning outside the classroom and those exposed to lecture instructional methods?
3. What is the difference between the mean achievement scores in chemistry of male and female students exposed to learning outside the classroom instructional method?

Hypotheses

The following null hypotheses guided the study and was tested at 0.05 level of significance.

1. There is no significant difference between the mean achievement scores in chemistry of students exposed to learning outside the classroom and those exposed to lecture instructional methods.
2. There is no significant difference between the mean achievement scores in chemistry of male and female students exposed to learning outside the classroom instructional methods.

Methodology

This study adopted two research designs. The first was a descriptive survey design used to address research questions 1. This is because the objective aimed at describing the different learning outside the classroom activities employed to engage students in learning activities in the schools under study (Nwankwo 2011). The second design was a quasi-experimental design used to address research question 2 and 3. This is because these

two objectives aimed at finding out the effect of learning outside the classroom on students' academic achievement in chemistry.

The population of the study comprised 28739 participants from 365 private schools in Port Harcourt metropolis. This included 625 teachers and 28114 students. Purposive sampling was adopted for the study. The criteria for the selection was based on private schools that frequently engage students on learning outside the classroom. Based on this criteria 102 out of 264 secondary schools in Qbio-Akpor Local Government Area and 84 out of 101 in Port Harcourt Local Government Area engage frequently in learning outside the classroom.

Five schools were randomly selected from each local government for the study. The ten schools were considered manageable and convenient for the researcher. In all 10 schools, intact classes were used for the study. A total of 259 participants comprising of 14 chemistry teachers and 245 chemistry students participated in the study.

For the treatment or Quasi- experimental part of the study, one school each was randomly selected from Qbio-Akpor and Port Harcourt Local Government Areas respectively. Intact classes of 19 (11 males, 8 females) and 27 (13 males, 14 female) chemistry students were used for the study. Two instruments were used for data collection in the study. The first is titled, "Learning Outside the Classroom in Chemistry Questionnaire (LOCCQ)". It was used to gather data for answering research 1. It was answered by teachers only. Respondents were required to write out the medium of (whether field trip or excursion) outside activity and the location of such activity for which students have been engaged. The second instrument was a Chemistry Achievement Test (CAT) which was used to gather data on students' achievement in Chemistry. It comprises 20 multiple choice questions to be answered by chemistry students with questions on the topics taught in the course of the experiment. The instrument for data collection was faced validated by three experts in the department of science education.

A reliability coefficient of 0.79 for CAT was obtain using Pearson Product Moment Correlation statistics. This was done by administering the test twice within two weeks' interval. A total of 259 copies of the instrument was distributed to the teachers and students by the researcher with the help of research assistants from the selected schools to enhance return rate. A total of 235 copies of the instrument consisting of 14 from teachers and 221 were retrieved from students. This was about 90.70%.

The procedural steps followed in the study were described below. Two intact class were used for conducting the study which was selected from the sampled schools. This was done by tendering the letter of permission to the principals of the selected school. One of the intact class served as the experimental group while the other class served as control group.

Given the permission to use the class, the researcher liaised with the Chemistry teachers to raise a letter to be sent to the fieldtrip venue through the school principals. After approval has been made by the fieldtrip venue, the researcher with the chemistry teacher conducted a brief orientation for the students regarding the aim of the field trip, what they should expect and the way they should conduct themselves. The Chemistry Achievement Test (CAT) was administered to them before they go on the fieldtrip as pretest. As part of safety precaution, they were asked to put on their lab coats. The Fieldtrip Lesson Plan was used for delivering instruction for experimental group. The class selected for the experimental group comprised 19 students with 11 male students and 8 females in an intact class from Port-harcourt metropolis, while students in the control class were exposed to lecture method, before them pretest was also administered to ascertain their level of understanding of chemistry, the class selected for the control group comprise 27 students with 13 male students and 14 female students in an intact class from Port Harcourt metropolis.

The research question one was analyzed using frequency count and percentage while research question 2&3 was analyzed using mean, the hypotheses were analyzed using t-test at 0.05 level of significance.

RESULTS:

Research Question 1: What are the different environment for learning chemistry outside the classroom in secondary schools in Port Harcourt?

Table 4.1: Environment, medium and Frequency of Learning Chemistry Outside the Classroom

Class	Chemistry Topics	Medium	Outdoor Activity	Location	Frequency (N=14)			
					VO	O	LO	N
SS1	Introduction to Chemistry	Field Trip	Identification of matters	Open field	8	3	2	1
SS1	Chemical Combination	Field Trip	Role play	Outside Classroom	6	7	1	0
SS1	Separation techniques	Excursion	Fractional Distillation	Petroleum Company	10	2	1	1
SS1	Acids Based and Salts	Excursion	Identification of Acids, Base and Salts	Chemical Industry	6	5	2	1
SS1	Water	Excursion	Water purification	Pure Water Company	4	3	3	4
SS1	Carbon and its Compounds	Excursion	Production of Ethanol	Local gin processing site	3	3	4	4
SS1	Chemical industries	Excursion	Identification of Chemicals	Chemical industrial	11	1	1	1
SS2	Chemical Reactions	Field Trip	Deliquescence	classroom	2	3	6	3
SS2	Water	Excursion	Water Pollution	A polluted river.	9	3	1	1
SS2	Hydrocarbon	Excursion	Fractional Distillation	Petroleum industry	4	4	5	1
SS3	Petroleum and or Crude Oil	Excursion	Identification of petroleum products	A visit to fuel station	7	6	0	1
SS3	Metals and their Compounds	Excursion	Identification of Metals	Visit to metal Fabrication site	4	2	6	2
SS3	Soap and Detergents	Excursion	Saponification	Soap making industry.	7	5	1	1
SS3	Giant Molecules (Sugars,	Excursion	Production of		2	1	5	6

Starch)

starch

Visit to
Cassava
processing
Site

Field Data, 2022

The result in Table 4.1 shows that the major learning Outside the Classroom medium employed for learning chemistry in secondary schools in Port Harcourt are excursions and field trips. The result shows that majority of the teachers 11 (78.6%) regularly take their students on field trip for identification of matters; majority of the teachers 13 (92.9%) often use role play often to demonstrate chemical combination; 12 (85.7%) often take students on excursion to petroleum company to observe fractional distillation; 11 (78.6%) often take students on excursion to chemical industry for identification of acids base and salts; 7 (50%) regularly take students on excursion to water purification company for observing water purification process; 6 (42.9%) often take students on excursion to local gin processing site to enable students observe the process of producing ethanol; 12 (85.7%) often take students on excursion to chemical industry to enable students identify chemicals; only 5 (35.7%) regularly take students on field trip outside the classroom to learn about deliquescence; 12 (85.7%) often take students on excursion to polluted river side to teach students about water pollution; 12 (85.7%) often take students on fieldtrip to road construction sites to teach students about air pollution; only 3 (21.4%) often take students on excursion to hospital to enable students see oxygen cylinder; 8 (57.1%) often take students to petroleum industry let students observe the fractional distillation process; 13 (92.9%) often take students on excursion to fuel filling station to let students identify petroleum products; 6 (42.9%) often take students on excursion to metal fabrication site to enable students identify different metals; 12 (85.7%) often take students on excursion to soap making industry to teach students about saponification; only 3 (21.4%) often take students on excursion to cassava processing sites to enable students learn the process of producing starch

Research Question 2: What is the difference between the mean achievement scores in chemistry of students exposed to learning outside the classroom and those exposed to lecture instructional methods?

Table 4.2: Mean Difference between Experimental and Control Group

Groups	N	Pre Test		Post Test		Mean Difference (Within)
		\bar{x}	SD	\bar{x}	SD	
Control	27	52.33	12.51	54.89	9.55	2.56
Experimental	19	53.68	16.52	76.68	6.31	23.00
Mean Difference (Between)		1.35		21.80		20.44

Field Study

Table 4.3 shows the mean scores of students taught organic chemistry using learning outside the classroom method and students taught organic chemistry using lecture method in the study area. The table shows a pre-test mean score of $\bar{x} = 53.68$ for the experimental group and a pre-test mean score of $\bar{x} = 52.33$ for the control group. This shows a difference of 1.35 in favour of the experimental group. This slight difference is not significant, indicating that the two groups were similar in chemistry performance. The table also reveals a mean difference of 2.56 for the control group and a mean difference of 23.00 for the experimental group between pretest and posttest scores. This indicates that the mean score in chemistry for the both groups improved after being taught using the two instructional methods. However from the table shows that the mean post-test score for the experimental group ($\bar{x} = 76.68$) was higher than that of the control group ($\bar{x} = 54.89$) by a difference of 21.90, meaning that students taught using outside classroom teaching method performed better than students taught using lecture method.

Research Question 4: What is the difference between the mean achievement scores in chemistry of male and female students exposed to learning outside the classroom instructional method?

Table 4.3: Mean Difference between Experimental and Control Group

Groups	N	Pre Test		Post Test		Mean Difference (Within)
		\bar{x}	SD	\bar{x}	SD	
Male	11	57.82	16.68	79.09	6.16	21.27
Female	8	48.00	15.51	73.38	5.15	25.38
Mean Difference (Between)		9.82		5.72		4.10

Field Study, 2022

Table 4.4 shows the mean scores of male students taught chemistry using outside classroom learning method and female students taught organic chemistry using outside classroom learning method in the study area. The table shows a pre-test mean score of $\bar{x} = 57.82$ for the male students and a pre-test mean score of $\bar{x} = 48.00$ for female students. This shows a difference of 9.82 in favour of the male students. This slight difference is not significant, indicating that the two groups were similar in chemistry performance. The table also reveals a mean difference of 21.27 for male students and a mean difference of 25.38 for female students between pretest and posttest scores. This indicates that the mean score in chemistry for the both groups improved after being taught using outside classroom learning method. However the table shows that the mean post-test score for male students ($\bar{x} = 79.09$) was higher than that of female students ($\bar{x} = 73.38$) by a difference of 5.72, meaning that male students performed better than female students taught using outside classroom learning method.

Discussion of Findings

Research one sought to identify the different learning outside the classroom medium employed for learning chemistry in secondary schools in Port Harcourt. The result showed that excursions and field trips were regularly used for learning Chemistry outside the classroom. Other medium sparingly used include: using the open field within school premises outside of the classroom where students sit or stand in a relax atmosphere to observe and listen to gain information.

Typical places students were taken to for outside of classroom learning included aside from open field and outside classroom within the school, Petroleum Company, chemical industry, pure water company, local gin processing site, chemical industry, classroom, a polluted river, road construction site, hospital, petroleum industry, visit to a fuel filling station, visit to a metal fabrication site, soap making industry and cassava processing site. While on these exercises, students learnt concepts such as Introduction to Chemistry, Chemical Combination, Separation techniques, Acids Based and Salts, Water, Carbon and its Compounds, Chemical industries, Chemical Reactions, Water, air, Oxygen, Hydrocarbon, Petroleum and or Crude Oil, Metals and their Compounds, Soap and Detergents, and Giant Molecules (Sugars, Starch). Students activities during the exercise included Identification of matters, Role play, observation of fractional distillation, identification of Acids, Base and Salts, observation of water purification, observation of process of production of Ethanol, identification of Chemicals, observation of deliquescence, water pollution, air pollution, exposure to a cylinder containing oxygen, identification of petroleum products, identification of Metals, observation of saponification and production of starch.

This result agrees with result obtained by Adebisi and Asaolu (2020) who found outdoor science learning activities in Basic Science and Technology to include: Organising visit to a site of polluted water; identification of living organism in different habitats and a visit to a nearby chemical factory among others. Adebisi and Asaolu also similarly found that outdoor science activities were often conducted for some topics while they were conducted less often for some topics.

Research three sought to ascertain the difference between the mean achievement scores in chemistry of students exposed to learning outside the classroom and those exposed to lecture instructional methods in secondary schools in Port Harcourt. The result showed that students exposed to chemistry instruction using outside classroom learning performed better than their counterparts exposed to instruction using lecture method. The test of hypothesis 1 which corresponds to research question 3 showed that there was a statistical significant difference between the performance of students exposed to chemistry instruction using outside classroom learning method and students exposed to chemistry instruction using lecture teaching method. This result agrees with the result by Oyovwi (2020) who conducted a study to examine the effects of outdoor science activities on student's academic achievement and retention in science in Delta South Senatorial District. Oyovwi found that there was a significant difference in the mean achievement scores between students taught using outdoor science activities and those taught without outdoor science activities. The result also agrees with that of Görkem and Gümüş (2020) who found that academic success levels of students in the outdoor education activities and outdoor education in social studies were significantly higher than those of the control group.

Research four sought to ascertain the difference between the mean achievement scores in chemistry of male and female students exposed to learning outside the classroom instructional method. The result showed that after the exposure to chemistry instruction using outside classroom learning, male students performed higher than their female counterparts. The test of hypothesis 2 which corresponds to research question 4 showed that there was a statistical significant difference between the performance of male and female students exposed to chemistry instruction using outside classroom learning method. This result disagrees with the result by Oyovwi (2020)

who found no significant difference in the mean achievement scores between male and female students taught science with outdoor science activities.

5.2 Conclusions

Based on the findings of this study, it was concluded that teachers in the study area engage students in learning outside the classroom through two major mediums which are excursion and field trips in addition it was found out that students exposed to learning outside the classroom performed better than those exposed using lecture method and also there was a significant difference between the male and female students academic achievement in chemistry that is exposed to learning outside the classroom

5.3 Recommendations

1. Students should be exposed to other informal mediums of learning outside classroom such as parents using their work activities related to chemistry and adventure camps. Such could make learning of chemistry occur in a more natural and relax atmosphere.
2. Learning outside the classroom instructional method should be employed regularly for teaching of chemistry as this method have been found to be effective in enhancing students' achievement and interest.
3. Seminars and Workshops should be organised to equip teachers with skill and knowledge of how to employ the method for teaching and learning of chemistry and other science subjects.

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