

EFFECTS OF HANDS-ON TEACHING STRATEGY ON SENIOR SECONDARY CHEMISTRY STUDENTS' ATTITUDE TOWARDS ORGANIC CHEMISTRY IN ILORIN METROPOLIS, KWARA STATE, NIGERIA

BY

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Abstract

This study investigated the effects of hands-on teaching strategy on senior secondary Chemistry students' attitude towards organic chemistry in Ilorin metropolis, Kwara State, Nigeria. The study specifically examined the attitudes of students towards Chemistry before and after treatment. The population of this study comprised 12,240 senior secondary school students in all public senior secondary schools in Ilorin metropolis, Kwara State, Nigeria. The sample consisted of 180 SSS II students. The sample was selected using multistage sampling procedure. Students Attitudinal Scale (SAS) were used to gather data used for the study. The face and content validity of the instruments were ensured by experts in Test-Measurement and the reliability was determined using test-retest method while the reliability of the instruments was determined using Pearson's Product Moment Coefficient Correlation; the analysis yielded reliability coefficients of 0.87 and 0.79 respectively. The data were analysed using descriptive statistics involving percentage, mean and standard deviation and inferential statistics of ANCOVA. The two hypotheses were tested at 0.05 level of significance. The findings from the study revealed that students' attitude towards Chemistry was negative before treatment and became positive after treatment; students taught with hands-on teaching strategy performed better than those taught using conventional teaching method. It implies that the hands-on teaching strategy is more effective for enhancing better performance in organic Chemistry. Based on the findings of this study, it was concluded that the hands-on teaching strategy is more potent in producing better performance outcomes in senior secondary school chemistry than the conventional method. It was recommended among others that Chemistry teachers should be made to recognize the potentials of hands-on teaching strategy and utilize it for better performance of students in Chemistry.

Keywords: Hands-on, teaching strategy, Chemistry, students, attitudes

Introduction

Science is the systemic activity of constructing and organizing knowledge in the form of explicit theories and universe forecasts. Science is a systematic approach that focused on facts for seeking and applying knowledge and understanding of the natural and social environments. Science is a systematized organization of knowledge in form of concepts, theories, laws, and generalizations. Science is the study of natural events or related concepts for the purpose of discovering its principles and laws (Achimugu, 2014).

Science and technology have reshaped the entire world to produce a new one commonly referred to as the modern world. Science and technology are interrelated; science contributes new knowledge which provides direct insights into new technological potentials. Science is a critical component of every country's growth and advancement.

Science learning is practical based and thus demands practical laboratory activities. It takes broad-based understanding in order for students to gain value in a world of choices and opportunities. Science learning uses experiments to empower learners with specific knowledge, abilities, attitudes and behaviours using enriching learning resources. Science education by experimental approaches allows students to validate science phenomena concepts, rules and theories.

Chemistry is the scientific field concerned with compounds, which are made of atoms, and it deals with elements and molecules, atomic combinations, compositions, shapes, properties and behaviours. Chemistry covers topics such as the interaction of atoms and molecules to form new chemical compounds. As a subject, chemistry, holds a transitional role between physics and biology and is often referred to as a core science because it provides a basis for studying both the fundamental and the applied science (Musa & Bolaji 2015).

The importance of Chemistry cannot be overemphasized in developing the science framework for a nation (including Nigeria). Chemistry is crucial to the development of a nation's science and technology and is one of the main science fields in classrooms. Chemistry is an applied science that systematically examines the structure of organic and inorganic materials, their properties and activities, as well as the different basic types of matter.

Despite the importance and relevance of chemistry to individuals and societies at large, evidences abound that students' performance in the subject is poor, particularly in external examinations. The West African Examination Council (WAEC) Chief Examiner's report (2015/2016) revealed that students are deficient in observation, problem analysis, documentation, calculation skills and practical experience.

Responding to questions from journalists about the constant mass failure coming from external examinations, the Registrar/Chief Executive of the National Examination Council (NECO) attributed the continued mass failure to different variables such as; the learners themselves, schools throughout the country, parents and the society. The teachers teaching chemistry and their teaching approaches are not left out too. (Adewale, Nzewuihe & Ogunshola 2016).

The active participation of the learner in classroom activities during chemistry lesson could be critical to their overall performance in the subject. There are many activity-based learning strategies that can be used in the science class particularly chemistry class. These include; discussion, games, excursion, role playing drama, project-solving method, computer simulation, hands-on and process-based approach among others. These methods are set to develop the students' critical thinking skills, creativity, open-mindedness and intellectual honesty (Adeniyi, 2012).

Understanding fundamental science concepts, acquiring laboratory skills, awareness of the connection between science, industry, the environment, and everyone's life in terms of benefits and hazards, and acquiring critical and logical thinking skills are among the objectives of studying science in secondary schools in Nigeria. (West Africa Examinations Council, 2014). These objectives necessitate the teaching and learning of science by experiments (by doing practical and making thorough observations that give meaning and relevance to understanding science). To broaden interest and curiosity, and to think creatively, learning and thinking capability must be established. For a teaching approach to be effective and acceptable it must be related to the dispositions of the learners and the style of learning that the approach intends to facilitate. A common example of an approach with these characteristics is hands-on teaching/learning strategy.

Hands-on learning can be described as an educational experience which allows active involvement of learners in manipulating objects to gain knowledge or understand a concept or a skill (Adeniyi, 2012). Hands-on learning is efficient in enhancing scientific skills and knowledge because it is a kind of learning that required practical manipulation of objects, equipment or apparatus. Ajayi (2017) defines hands-on science as a method of teaching that involves activities and direct experiences with natural phenomena. It can be seen as activities that involve students having objects (both living and non-living) directly available for investigation.

A hands-on approach is an instructional technique in which the learner is deliberately encouraged to do something in order to learn about it. In a nutshell, it is "learning by doing." Furthermore, the hands-on approach helps students to learn and grasp what is going on. Hands-on is an activity based instructional method which facilitates learners' active participation in the learning process. In this method, learners are engaged in activities that are learners initiated, based on task assigned by the teacher. These activities are built upon the natural curiosity of the learners.

Attitude is the propensity of an individual about an issue. It dominates behaviour and causes bias in decision-making process. Attitude towards chemistry is the positive or negative view point about the teaching or learning of chemistry. Based on the researcher's experience as a classroom teacher, attitudes are created by following the example or viewpoints of others (teacher, parent, or friend). It may also be a result of imitation in a teaching-learning setting. As a consequence, the learner adopts the teacher's attitude in order to shape his own, which has an effect on his or her learning outcomes. Students develop negative attitudes, according to Gabriella (2013), as they encounter regular and recurrent errors or difficulties when performing or carrying out tasks, and these negative attitudes may become relatively permanent. This scholar went on to say that when children first start kindergarten, they have a positive attitude toward science rather than a negative attitude. However, when they get older, their attitudes become less positive and, by the time they get to the senior year, their attitude are often negative. It was discovered that there is a substantial disparity in attitudes toward science between junior and senior students, with senior classes having lower attitudes than junior classes.

Study on student attitude to chemistry learning was carried out by Nwarri (2014). The study consisted of all 10th students at five Jerusalem private schools, totalling 103 students (49 boys and 53 girls). In order to evaluate student attitudes towards chemistry, a questionnaire was planned. It dealt with the teacher's role in addressing the content. The results show that whether the student is a male or female, the student has an attitude towards studying chemistry. This may be mostly attributed to the nature of the subject, the lack of knowledge of the importance of chemistry part of people's everyday lives.

Abulude (2016), through selected secondary schools of the Akure South Local Government Area of Ondo State, Nigeria, studied the attitude of teachers and students towards chemistry. Three hundred students from five randomly chosen schools participated in the study (200 males & 100 females) in their final year (Senior Secondary School). The data was gathered using a questionnaire validated by an expert team. Descriptive indicators were used to analyze the situation. The findings indicated a negative attitude towards chemistry by students and their teachers. The studies have shown that the student's attitude to the subject is influenced by insufficient textbooks, poor education material and challenges related to government administration. There were some important suggestions to help direct and develop the attitudes of students to the study of chemistry.

Yunus and Ali (2012) discovered that the attitude of students in urban area toward learning chemistry is positive and have confirmed that most urban students have a good attitude in the laboratory toward learning chemistry and that students are also positive towards instructional styles. The results further demonstrate that most students are negative in their attitude towards chemistry because they do not have an interest in the subject and the curriculum itself.

Jassem (2014) has also researched chemistry student attitudes, examining options and choices. Furthermore, while the understanding of chemistry as a challenging subject, most students were positive about their learning with the majority of comments. Moreover, the respondents stated that chemistry is a fascinating subject and not a dull one, which obviously requires greater care to increase its status. Having assistance at home and from teachers was an important factor in the preference of the student for chemistry but there is a disadvantaged option for different professions which may impede the students' interest in chemistry.

Statement of the Problem

Considerable attempts have been made at researching on some variables that cause poor performance of students in chemistry but none has focused on the effects of hands-on teaching strategy on student's performance in chemistry. So far, research has concentrated on teacher-centred issues in the instruction of science subjects. Motivational orientation, self-esteem/self-efficacy, social problems, study habits, and low interpersonal relationships are among the other variables linked to poor performance. Given the wide-ranging impact of low academic performance to students, parents, culture, and the government, it is fitting and should be a welcome development to investigate. This will allow for the provision of strategies to improve students' performance.

There is the need to look at the effect of using modern innovative methods to teach Chemistry. Evidences abound that hands-on teaching strategy could be used to effectively facilitate better performance of students in Chemistry. This study is faced with the problem of verifying the effects of hands-on teaching strategy on students' learning outcome in Chemistry.

Research Hypotheses

The following null hypotheses were generated to guide the study;

1. There is no significant effect of hands-on teaching strategy on students' attitudes towards organic Chemistry among senior secondary students in Ilorin metropolis of Kwara State.
2. There is no significant effect of hands-on teaching strategy on students attitude toward organic chemistry based on gender among senior secondary students in Ilorin metropolis of Kwara State.

Research Method

In this study, the research design adopted was a pre-test, post-test, control group quasi experimental design. In addition, a factorial research 2 x 2 design was adopted to test the null hypotheses for this study. The population for this study consisted of 12,240 Secondary School Two (SSSII) Chemistry students across Ilorin metropolis Kwara State. As at the time of this study, Ilorin metropolis had 102 public secondary schools (Kwara State Ministry of Education and Human Capital Development, 2019). The sample for the study consisted of 180 students. Multistage sampling procedure was used for the selection of the sample. At the first stage, random sampling technique was used to select three Local Government Areas in Ilorin metropolis of Kwara State. Random sampling was used to select the sample because each of the local government area in Ilorin metropolis have equal chances of being used as sample. At the second stage, purposive sampling was used to select two schools from each of the Local Government Area to make a total of six schools based on the following criteria; schools that were co-educational; schools that were not situated in the same location, so as to take care of interaction effects on the part of the students. Three of these schools were randomly assigned to the experimental group, while the last three school were assigned to the control group. At the last stage, intact classes of Senior Secondary School II (SSS II) students offering Chemistry from each of the six secondary schools were used for the study. These were the science arms of the class, and each of the schools had one science class each.

Two research instruments were used for the study. They are Organic Chemistry Performance Test (OCPT) and Students Attitudinal Scale (SAS). OCPT consisted of 20 items multiple choice questions with five options (A-E) culled from WASSCE past questions. It was used to determine students' performance in Organic Chemistry. It also served as the retention test. The Students' Attitudinal Scale (SAS) was made up of two sections; A and B. Section A consisted of students' biodata while section B consisted of 20 items on attitude used to measure students' attitude towards Chemistry. The items were rated on a 4-point Likert type scale of, Strongly Agree (SA) – 4, Agree (A) – 3, Disagree (D) – 2, Strongly Disagree (SD)-1. The two research instruments were given to experts in Test and Measurement, guidance and counselling and those in the field of Chemistry for face and content validity.

The reliability of the instruments was ensured by using test-retest method on selected secondary schools outside Ilorin Metropolis. The sets of responses were compared using Pearson's Product Moment Correlation Statistics. Reliability coefficients of 0.87 and 0.79 were obtained for OCPT and SAS respectively at 0.05 level of significance. The coefficients were considered high enough to adjudge the instruments as reliable. Data collected for this study were analysed using descriptive and inferential statistics. The research questions were answered using percentages, mean and standard deviation while all the hypotheses were tested using two-way Analysis of Covariance (ANCOVA) at 0.05 level of significance.

Results

H₀₁: There is no significant effect of hands-on teaching strategy on students' attitudes towards organic Chemistry among senior secondary students in Ilorin metropolis of Kwara State.

To test hypothesis 1, the pre-test and post-test scores of students in Chemistry for the experimental (Hands-on Teaching Strategy) and control group (Conventional Teaching Method) were analysed using ANCOVA at 0.05 level of significance. The result is shown in Table 1.

Table 1

Result of Analysis of Covariance on the Differences between the Experimental Group (Hands-on teaching Strategy) and Control Group (Conventional Teaching Method)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	37972.56 ^a	2	18986.28	218.75	.00
Intercept	15926.93	1	15926.93	183.50	.00
Pre-test	3997.10	1	3997.10	46.05	.00
Groups	24792.15	1	24792.15	285.64	.00
Error	15362.64	177	86.81		
Total	422168.00	180			
Corrected Total	53335.20	179			

a. R Squared = .71 (Adjusted R Squared = .71)

The result of the ANCOVA analysis as depicted in Table 1, shows that $F_{(1,177)} = 285.64$, ($p = 0.00 < 0.05$). This implies that the treatment (Hands-on teaching strategy) had significant effect on the attitude of Chemistry students' and hypothesis 1 is therefore rejected. This implies that there was a significant effect of hands-on teaching strategy on senior secondary school students' attitude in organic Chemistry in Ilorin metropolis, Kwara State.

H₀₂: There is no significant effect of hands-on teaching strategy on students attitude toward organic chemistry based on gender among senior secondary students in Ilorin metropolis of Kwara State.

To test hypothesis 2, the interaction effect of gender on students' scores in Chemistry for the experimental (Hands-on Teaching Strategy) and control groups were analysed using ANCOVA at 0.05 level of significance and the result is shown in Table 1.

Table 2

ANCOVA of the Interaction Effect of Gender and Treatments (Hands-on Teaching Strategy) on Senior School Students' Academic Performance in Chemistry.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	39675.38 ^a	4	9918.85	127.07	.00
Intercept	15386.56	1	15386.56	197.12	.00
Pre-test	3528.87	1	3528.87	45.21	.00
Groups	23446.71	1	23446.71	300.38	.00
Gender	563.67	1	563.67	7.22	.01
Groups*Gender	1147.81	1	1147.82	14.71	.00
Error	13659.82	175	78.06		
Total	422168.00	180			
Corrected Total	53335.20	179			

a. R Squared = .74 (Adjusted R Squared = .74)

Table 2 shows the effect of gender with F-value of $F_{(1,175)} = 7.22$, $p = .01 < 0.05$, treatment with $F_{(1,175)} = 300.38$, $p = .00 < 0.05$ and interaction effects of gender and treatment with $F_{(1,175)} = 14.71$, $p = .00 < 0.05$, Hypothesis 2 is therefore rejected. This implies that there was significant interaction effect of gender and hands-on teaching strategy on senior secondary school students' learning outcomes in Chemistry in Ilorin metropolis, Kwara State.

Discussion

The finding of this study showed that the SSS II Chemistry students' attitude towards Chemistry before treatment was negative. This could be as a result of the methods adopted in teaching Chemistry and the use of obsolete instructional materials and textbooks in the teaching and learning of Chemistry in secondary schools. Also, the negative attitude of the students before exposing them to hands-on teaching strategy might be as a result of lack of interest, erroneous beliefs that Chemistry is volatile, and poor motivation by teachers. This finding is in consonance with that of Abulude (2016) who reported that students and teachers both had a negative attitude to Chemistry.

The result showed that Chemistry students' attitude towards Chemistry after treatment was positive. Also, the study found significant difference between students' attitude toward Organic Chemistry in experimental and control group. The finding is in consonance with that of Jegede and Adedayo (2013) who explained that students showed more positive attitude toward science in hands-on classrooms activities. Similarly, Festus (2012) showed that students who were instructed with hands-on activities showed positive attitude towards chemistry than students instructed with teacher demonstrations. Another study conducted by Holstermann, Grube and Bogeholz (2010) revealed that students with hands-on experience were likely to report higher interest in the hands-on activities than students without experience.

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