Evaluating the Impact of Chemistry Practicals on Students' Performance in Chemistry in Public Secondary Schools of Nasarawa State Nigeria

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Abstract: **The study investigated the impact of chemistry practicals on students' performance in chemistry of public secondary schools of Nasarawa state, Nigeria. The study was conducted in Akwanga, Nasarawa-Eggon and Wamba LGA in Nasarawa North Senatorial zone. This study utilized a quantitative approach, with a quasi-experimental design. The design was in form of pre and post-test. Questionnaire was used to collect data. The main population for the study comprised all the public secondary schools offering chemistry in the zone from which 15 sample schools was selected using a combination of stratified, purposive and systematic sampling procedures. It involved 30 chemistry teachers `and 300 SS2 chemistry students comprising 200 boys and 100 girls. Descriptive statistics such as mean and standard deviation were used and independent samples t-tests. The study established that the use of chemistry practicals in teaching and learning of chemistry at secondary schools greatly improved performance. The findings shows that there was a significant difference in performance between students who studied chemistry through practicals and those who studied chemistry without practicals. The study recommends intensive in-service training for chemistry teachers in practical work management and latest research to improve their practices.**

***Keywords*: Chemistry, Practicals, Academic performance, Secondary School, Impact**

I. INTRODUCTION

Chemistry is one of the subjects that is offer in the Nigeria secondary school curriculum. It is an important part of what is called science and an active and continually growing science that contribute to national development [5]. According to Ogunkola [14], chemistry is characterized as the most utilitarian of all the experimental sciences. For example, in Nigeria Universities, a good grade in chemistry is a prerequisite for joining all professional science courses like medicine, pharmacy, nursing, Agriculture science, Engineering and many others. Poor performance in the subject means fewer students are able to join such professions, therefore lack of enough professionals leading to low health care provision and food insecurity in the country. Chemistry is known to be the science that has the most direct and dramatic impact on our lives, and the science that shapes the world we will live in tomorrow, the performance of students in the subject is a major concern to any developing country [12]. The uniqueness of chemistry and the central role that it stands to play in the development of any nation when considered, are however, not evident in the performance of the students. The poor performance in chemistry in the national examinations (NECO/WASSCE by many candidates has been a subject of debate since the inception of 6-3-3-4 system of education in Nigeria [8,6]. This is an indication that the teaching and learning of this subject in secondary schools has not been well. Improvement in learners' performance in chemistry will greatly help in the achievement of the Nigeria Vision 2020" which proposes intensified application of science, technology and innovation (STI) to raise productivity and efficiency levels in Nigeria and sub-sahara Africa [7,18].

In chemistry, one area that requires urgent reforms are the are the chemistry practicals, where it is important to rethink the role and place of chemistry practicals in the learning and teaching of chemistry. Over the years, many have argued that science cannot be meaningful to students without worthwhile practical experiences or practicals in the school laboratory [11]. Typically, the term practicals mean experiences in school settings where students interact with materials to observe and understand the natural world.

Practicals are designed and conducted to engage students individually or in small groups, a method referred to as class experiment or in large-group demonstration settings, which is known as teacher demonstration method. Since chemistry is a practical science, teaching and learning of chemistry should involve chemistry practicals [3]. Practical work has been able to promote students' positive attitudes and enhance motivation for effective learning in chemistry and other science subjects as described by [15]. Consequently, a positive attitude toward the importance of practical work meaningfully affects students' achievement in science [10].

II. STATEMENT OF THE PROBLEM

In the Nigerian system of education, chemistry is not an optional science subjects (compulsory) to all secondary school students intending to study sciences. chemistry practical's are given a central and distinctive place in the teaching and learning of chemistry at the secondary school and all levels. Although chemistry practical's often occupy a massive share of curriculum time and resources, doubts have been raised about their effectiveness or their real educational value, as students continue to perform poorly in the subject [7]. Therefore, this study sought to find out the impacts of chemistry practicals on students‟ performance in chemistry in Nigeria public secondary schools in a bid to improve the academic achievement in the subject.

III. PURPOSE OF THE STUDY

The purpose of this study is to investigate the impacts of chemistry practicals on performance in chemistry among public secondary school students of Nasarawa state, Nigeria

The specific objectives are**:**

i. The study was designed to investigate the impacts of chemistry practical on the performance in chemistry in the pre-test among public secondary schools.
ii. To determine whether there was a significant difference in chemistry practical on academic performance in the post-test.

The study tests the null hypothesis (H0) as follows;

H0: There is no significant difference in the mean score on students' achievement test of students exposed to chemistry practical's and those not exposed.

IV. METHODOLOGY

a. Research design, methods and research tools

The study used descriptive survey design to investigate the impacts of chemistry

practical on the performance of students. The study employed a quasi-experimental research design specifically pre-test and post- test experimental and control group design. The current study started with observation as promising way forward to identifying the existing problem of poor performance in chemistry and related hindrances within an academic environment. Thereafter, both formative and summative evaluation of students were given priority during data collection in the so-called pre-test and post-test non-randomized control and experimental group. Apart from tests given to students, a questionnaire was designed, the questionnaires targeted chemistry students and chemistry teacher of which is the target population comprising of 300 students and 30 teachers.

b. Data collection procedures, data analysis and presentation

Students' achievement tests (SAT) were used to collect data from tests performed SS2 students who were purposively distributed into two groups namely the control group and experimental group. SAT was designed for pre- and post-test, both comprised 15 multiple choices items, which were drawn from the selected topic. Both groups were taught the topic. A pre-test was administered for 30mins in the first week to both groups as a graded assessment tool to determine the preliminary knowledge and skills before applying different teaching approaches **while** the post-test was also administered for 30mins in the last week. In all circumstances, the measurement of performance was conducted to measure the extent to which teaching methods influenced the learning attitudes and performance in chemistry.

V. RESULTS AND DISCUSSIONS

The results of the analysis and discussions of findings of this study are as follows:

Number of Respondents

The study sought details on the number of respondents of this study. Table 1. shows the results obtained.

Table 1: Number of respondents

Respondents	M	%	F	%	Total	%
Teachers	18	69.2	8	30.8	26	100
Students	200	70.1	85	29.9	285	100

The results in table 1 indicated numbers of respondents on gender bases with 69.2% of the chemistry teacher male and 30.8 % of the teacher's females. The table also shows male students 70.1% and 29.9 % female students. The study involved only senior secondary two (SS2) students and the chemistry teachers in the selected public secondary schools.

Respondents' Group Type

The study used the quasi-experimental approach of the pre-test and post-test design. The respondents were categorized as either the experimental group or the control group. The experimental group consisted of students taught using methods integrating chemistry practicals while the control group consisted of students taught using methods without chemistry practicals. Table 2 shows the data on the respondents‟ group type.

Table 2: Distribution of Respondents' Group Type

Respondent Group Type	N	Percentage (%)
Experimental	243	85.3
Control	42	14.7
Total	285	100

Table 2 shows that 85.3 % of the respondents formed the experimental group while 14.7% the control group. The percentage of respondents in the control group is far much lower than in the experimental group. This is because most schools did not want to participate in the study as control groups where the teaching and learning of chemistry was to take place without chemistry practicals. [13] reported similar challenged in his work.

Chemistry Practicals and Students' Performance in Chemistry

The first objective of the study was to establish whether students learning chemistry using chemistry practicals perform better than those learning without. To achieve this objective, the study sought details on the performance of the pre-test and post test administered to all students involved in the study. The study tested first null hypothesis, H0, that there is no significant difference between the post-test mean score in chemistry of students exposed to chemistry practicals and those not exposed. Table 3, gives summary of the descriptive statistics on the pre-test and post-test analysis results.

Table 3: The pre-test and post- test analysis results.

.	N	Mini. Score	Max. Score	Mean	S.D
Pre-test	285	15	55	12.04	2.11
Post-test	285	20	57	13.11	2.83

Table 3 shows results, the findings indicate that there was an increase of minimum and maximum scores from the pre-test scores to the post test. The findings shows that the mean for the pre-test was 12.04 and the mean for post-test was 13.11. The mean values indicated a small difference of 0.87. The improvement from the pre-test score to the post test score, indicated that chemistry practicals have a small positive effect on learners' performance.

Performance of Students in Experimental and Control Groups

The study sought to test the null hypothesis, H0**,** that there is significant difference between the post-test mean score in chemistry of students exposed to chemistry practicals and those not exposed to practicals.

Table 4: Descriptive Statistics on Post Test Scores of Experimental and Control Groups

Test Type	N	Mini. Score	Max. Score	Mean	S.D
Post-testExperiment	243	20	58	22.65	3.11
Control	42	10	55	21.14	3.40

Table 4 shows the descriptive statistics of the post test scores for both experimental and control groups. In experimental group, N=243 had a mean score of 22.65 and a standard deviation of 3.11. In the control group, N=42 had a mean score of 21.14, and a standard deviation of 3.40. the findings, shows the experimental groups mean score higher than the control groups mean score implying that the chemistry practicals treatment had a positive effect on students‟ performance in chemistry. The small difference in the mean for the experimental group and control group obtained from this study agrees with the results reported by [1] and [13] from similar findings in Tanzania and Kenyan.

The test was used to decide whether to accept or reject the H0. That is, to determine whether there is a statistically significant difference between the means of the post-tests scores of the two groups. This is because the independent-samples t-test (or independent t-test, for short) compares the means between two unrelated groups on the same continuous, dependent variable.

Table:5 T-Test Results on Post Test Scores between Experimental and Control Groups

Independent.	T-test	T	DF	Sign. (2 tailed)	Mean difference	Std.Error difference
Post-test equal variance assumed		2.27	312	0.000	1.33	0.235

Table 5 shows the results of the independent T-test on post test scores between experimental and the control groups. Assuming equal variances, the findings show that the t-value is 2.27 with degrees of freedom of 312. The two-tailed p value associated with the test is 0.000, at an alpha value of 0.05 level of significance, so we do not accept but reject the **H0**. This implies that there is a significant difference between the pre-test mean scores in the chemistry achievement test of students from the experimental group and control group.

Table 6: Descriptive Statistics on Pre-Test Scores of Experimental and Control Groups

Test Type	N	Mini. Score	Max. Score	Mean	S.D
Pre-test Experiment	243	10	69	13.05	2.15
Control	42	15	65	13.14	2.03

Table 6 shows the descriptive statistics for both experimental and control group. In the experimental group, the mean is 13.05 while the control group the mean is 13.14. From these findings, the groups mean score are almost equal with a difference of 0.09 implying that the two groups of students were similar in chemistry achievement before the treatment was done.

Table 7 shows the results of the independent T-test on pre-test scores between experimental and the control groups. The test was used to decide whether to accept or reject the H0. That is, to determine whether there is a statistically significant difference between the means of the pre- test scores of the two groups.

Table 7: T-Test Results on Pre–Test Scores between Experimental and Control Groups

Independent (2 tailed)	T-test Difference	T	DF Difference	Sign.	Mean	Stand. Error
Pre-test equal variance assumed		2.01	422	0.14	0.11	0.312

Table 7 shows that the t value is 2.01 with degrees of freedom of 422. The two-tailed p value associated with the test is 0.14. From the decision rule that: If $p \leq \alpha$, then reject H0, then in this analysis, 0.14 is greater than 0.05, so we accept H0. This implies that there is no significant difference between the pre-test mean scores in chemistry of students exposed to chemistry practicals and those not exposed.

VI. CONCLUSIONS

In conclusion, the findings of the study impact of chemistry practical on the performance of chemistry students established that the use of chemistry practicals is an effective method in improving students' performance in chemistry in secondary schools regardless of their gender. Use of chemistry practicals enhances students‟ knowledge and understanding in a better way compared to none use of the chemistry practicals.

The study also showed that exposure to various types of chemistry practicals had a significant positive effect on students‟ performance. Students have a lot of benefits from chemistry practicals. Chemistry practicals increase students‟ interest and abilities in science subjects as well as their performance in science. This is because chemistry practical classes help students in understanding theories and chemical principles which are difficult or abstract. Moreover, chemistry practicals offer several opportunities to students such as: developing scientific thinking and enthusiasm to chemistry, developing basic manipulative and problem-solving skills, hands-on experience in using instruments and apparatus, and identifying chemical hazards and handling chemicals safely and other science process skills.

VII. RECOMMENDATIONS

Based on the findings, the study recommends the following:

To strengthen learning and performance in chemistry, government should provide more laboratory equipment's to public secondary schools in the state. There is also a need for the government to construct proper chemistry laboratories in secondary schools that are offering chemistry without laboratories.

There is need for government to organize intensive in-service training for chemistry teachers in practical work management and latest research to improve their practices. Teachers should be allowed to attend seminars and workshops to receive training that will expose them to various types of local teaching materials and how to use hands-tools so that they can improvise, where possible, science equipment for practical work.

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