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FOSTERING STUDENTS' PERFORMANCE AND INTEREST IN QUANTITATIVE AND QUALITATIVE ANALYSES OF CHEMISTRY PRACTICALS THROUGH LABORATORY – BASED STRATEGY IN SECONDARY SCHOOLS IN KOGI STATE, NIGERIA

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ABSTRACT

This study examined the laboratory-based learning strategy in fostering senior secondary school students' academic performance and interest in quantitative and qualitative analyses of chemistry practical in Kogi State, Nigeria. Four research questions and four null hypotheses guided the study. The study adopted quasi-experimental of protest post-test non-equivalent control group design. The population of the study was 3,621 senior secondary II chemistry students for 2023/2024 academic session in Ankpa LGA, Kogi State. A sample of 184 (88 males and 96 females) SSS II students from two intact co-educational secondary schools purposively sampled in the study area. Quantitative and Qualitative Analyses Achievement Test (QQAAT) and Quantitative and Qualitative Analyses Interest Inventory (QQAAII) were used for data collection. The two instruments were validated by experts and trial tested. Reliability coefficients of 0.89 and 0.92 for QQAAT using K-R_{21} and for QQAAII using Cronbach Alpha. Descriptive statistics of mean and standard deviation were used to answer the research questions posed while Analysis of Covariance (ANCOVA) was used to test the research hypotheses formulated and tested at 0.05 alpha level of significance. The findings of the study indicated that laboratory-based learning strategy had a significant effect on students' interest and performance in qualitative and quantitative analyses of chemistry practical. This implies that, chemistry students taught with laboratory-based learning strategy significantly achieved better in qualitative and quantitative analyses of chemistry practical than those taught with alternative- to practical method. In addition, the study equally reveals no significant difference in the interest and academic performance of male and female school students exposed to laboratory-based learning strategy. It was concluded that laboratory-based learning strategy has the strength to positively foster interest and academic performance irrespective of students' gender. Based on these findings, it is recommended that curriculum planners should emphasize and incorporate the use of laboratory-based learning strategy in the teaching of chemistry practical.

Keywords: Achievement, Gender, Interest, Laboratory-Based Learning Strategy and Alternative-to-practical strategy.

Introduction

Chemistry as a subject is made of concepts which require complex mental process that involves visualizing, manipulating, analyzing, abstracting and associating with idea (Egbutu, 2014). It is the vehicle through which chemical knowledge and skill reach the people who are in need of capacities and potentials for

development (Ibrahim *et al*., 2017). It is a prerequisite for enrolment into scientifically inclined careers such as medicine, engineering, pharmacy, biotechnology, agriculture and the like, in postsecondary educational institutions (Mwangi, 2016). Teaching of chemistry helps to instill scientific knowledge and stimulate science-oriented attitude in learners (Igwe, 2015). Just like the other science subjects, chemistry has both theoretical and practical aspects which complement each other during the teaching and learning process as such it is a mandatory requirement for effective implementation of chemistry curriculum (Mwangi, 2016). Whereas the subject's theoretical aspects can be studied by traditional methods, the study of its practical content entails conducting experiments. These experiments are to demonstrate practically some of the principles taught in theory, test the validity of certain empirical chemical laws and illustrate properties of substances taught theoretically in the classroom (Odutuyi, 2015).

On this note, practical chemistry is designed to help teachers and students to execute the study of chemistry more successfully and with better understanding (Walter, 2021). In order to make chemistry practical an organized experimental study, the senior secondary school chemistry curriculum (FME, 2009) encompasses practical activities covering separation techniques, quantitative analysis, qualitative analysis (salt analysis), preparation and test for gases, heat change and oxidation and reduction. Aspect of the chemistry practical requires several laboratory skills on the part of the students. These skills include skills of measurement, manipulation, observation, colour identification, collecting data, communicating, experimenting, identifying patterns, inferring, interpreting, organizing and analyzing data, among others (Ogunleye, 2016). At secondary school, practical chemistry lays emphasis on the student's acquisition of thorough knowledge of apparatuses and their uses; laboratory skills and understanding of intriguing calculations that deepens the students' grasp of basic theoretical concepts. Students that are frequently exposed to practical work with guidance by their teachers have better understanding of theoretical concepts and can easily associate them with the practical work (Akusoba, 2012).

There are a number of reasons why practical activities is of great importance to students' acquisition of development skills (Boud e*t al*., 2019; Udogu & Emendu, 2017). At first, practical activity helps to familiarize students with such mental processes as counting, measuring, observing, classifying, and inferring hypothesizing, interpreting and so on. Secondly, practical activities stimulate and maintains the interest of students in science specially chemistry. Thirdly, it induces the scientific attitudes like curiosity, perseverance, honesty, objectivity and endurance. These skills can be achieved, through the provision of experiences and resources that may help develop analytical thinking, problem solving, scientific, technical skills and many more, through examining and interpreting experimental results and making evaluations which have been reported as employability skills (Okonkwo & Samuel, 2020). Gazi *et al*. (2010) equally regarded chemistry practical as very important for various reasons which include motivation, concept learning, development of manipulative abilities, inquiry skills and the development of appropriate scientific attitudes such as curiosity, honesty, perseverance and open mindedness.

In spite of the relevance of chemistry and its practical activities to national development, students' performance in both internal and external examinations have been consistently

poor (Nbina & Auwiri, 2014; Graulich, 2015; Ejidike & Oyelana, 2015; Hanson, 2017; Eze & Okorie, 2019; Anyanime & Abasifreke, 2019; Adu-Gyamfi *et al*., 2020; Onyi *et al*. 2022; Odukwe & Nwafor, 2022; Aniodoh & Eze, 2022). This incidence of failure has been linked to students' poor or lack of exposure to chemistry practical activities (Ogunleye & Bamidele, 2014). Many reasons have been attributed for the observed poor performance and lack of interest in chemistry by students. One of the reasons according to WAEC Chief Examiners' Reports (2022) who reported that, chemistry students were unable to carry out required tests; demonstrated inadequate exposure to practical work; had poor knowledge of separation techniques; could neither record observations made nor make inferences; lacked accuracy in burette readings; had no understanding of the demands of questions; did not adhere to rubrics; lacked manipulative skills; and could not draw logical inferences from observations made.

Another reason is reported by Anyanime and Abasifreke (2019); Nwanze *et al*. (2021); Nwagbo (2015) who linked students' low achievement in chemistry to teachers' use of ineffective strategies of teaching practical which do not make room for active learning. Nwanze *et al*. (2021) equally disclose that teachers adopt alternative-to practical learning strategy and this has continued to pose serious challenges for students in the learning of chemistry. This strategy has been criticized as a practical training which is done outside the laboratory preferably in the classroom as the training having less impact to critical practical areas (Walter, 2021). To Isa *et al*. (2020), this strategy does not apply activity-based learning to encourage students to learn real life problems based on applied knowledge. As a result of this, a shift is therefore advocated by Nnorom (2015) to strategies that will enable the learner to construct his/her own understanding. For learners to actively construct meaning there is need to use learner-centered strategies of teaching which was emphasized in the Nigerian National Policy on Education (FRN, 2013). These strategies aid ascertainment of scientific facts, concepts and principles and help in nurturing the learners' scientific process skills (Kaptingei & Rutto, 2014). No wonder, Okono (2015) disclose that the teaching of chemistry through using experimentation pedagogical strategies contributes to effective teacher instruction and increases mastery of concepts by the learners. To achieve this, laboratory-based learning strategy becomes necessity in this study.

According to Nekang (2016), laboratory-based learning strategy is a strategy that leads the students to carry out material experiments, observe, feel, touch, approximate, and estimate. Tambo (2012) sees laboratory- based learning strategy as a learning interaction in which students, under the guidance of a teacher, investigate some aspect of a topic. Tambo further put it forwards that, the effective use of laboratory-based learning strategy has four stages which include: planning, introduction, the work period and culminating activities. Theoretically, this study was anchored on the theory of Philosopher John Dewey and Educational theorist David Kolb. Philosopher John Dewey advocated the idea of "learning by doing", which is a very student-centered approach to teaching and learning. He wrote, "Give the learners something to do, not something to learn; and the doing is of such a nature as to demand thinking; learning naturally results". When students are presented with such real-life problems which they must activity engage with and solve through hands-on strategies, considerable learning takes place (Dewey, 1938). This leads to active

discovery and acquiring procedural skills instead of rote learning of facts (Aubrey & Riley, 2016).

Kolb's theory of experiential learning by educational theorist David Kolb was also influenced by Dewey's work about the importance experience in the process of learning (Kolb, 2015). This theory proposes that for learning to take place, an individual should first actively participate in an activity (concrete experience), such as laboratory practical and then reflect back on what he or she has learnt, whist trying to also make connections with past experiences. Here strengths and weaknesses can be identified (reflective observation). Next, the student analyses his or her reflection, integrating previous knowledge and theories to the learning experience (Abstract conceptualization). In the last phase, the newly acquired knowledge is applied to new experiences (active experimentation) (Kolb, 2015). Hence, Kolb's experiential learning cycle connects theory to practice and also reflection to action (Lucas *et al*., 2012). Through practical lessons, students are given the chance to reflect on and evaluate their work, especially through the evaluation sheet. This provides them with the opportunity to identify mistakes and build on their skills in subsequent practical sessions (MC Dowell *et al*., 2015). Empirically, the studies conducted by Abakpa *et al*. (2016); Walter (2021); Jitzi (2019); Isha and Magaji (2018); Chibabi *et al*. (2018); Ezeano and Ugwu (2018); James *et al*. (2019); Kalu *et al*. (2019); Abbey and Vikoo (2019) reported that students taught using laboratory-based learning strategy performed better than those taught using traditional teaching strategies in senior secondary schools. These studies further showed that males and females benefited significantly from the laboratory learning strategy since it is activity oriented which made them engage in in-depth critical thinking and process skills

Academic performance is an important academic factor that is influenced by teaching strategies. Performance is the outcome of instruction and students' mastery of particular learning contents (Usang & Josephine, 2021). Konyefa and Okigbo (2021) see performance as the grade obtained through achievement test through which the teacher evaluates the extent to which instructional objectives have been achieved. This refers to performance of students in a school subject as designated by a score or mark obtained in a performance test (Abd *et al*., 2020). Gender issues have been linked with performance of students in academic tasks in several studies but without any definite conclusion. Gender is a personal variable that has been proved to have considerable influences on students' academic self-efficacy and performance (Ushie & Edinyang, 2018). The influence of gender and its interaction with instructional strategies have remained inconclusive. Studies had shown that certain instructional strategies favour males more than females and others reported otherwise. Some teaching strategies tend to be gender sensitive (Izuegbunam, 2018) while others are more gender bias or specific (Nwanze, 2016). Effective instructional strategies however, must have the potency to positively enhance performance irrespective of students' gender.

Student's interest is another factor that affects students' performance in chemistry. Interest simply entails eagerness to learn a set out task or activity for positive and near mastery of the skills and knowledge related to the activity (Unachukwu & Okoli, 2020). Oguche and Usman (2019) see interest as an aspect of affective domain which has to do with one's readiness to like or dislike something. In addition, Ojekwu and Ogunleye (2020) see students' interest as

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critical in the teaching learning process. Lebata and Mudau (2014) have observed that most learners perform below average due to lack of interest; they are neither motivated to learn nor do what they are expected to do. In line with this, Adeyemi and Adeyemi (2014) noted that when students lose interest in their studies, failure rate will be higher. While Onu *et al*. (2020) reported that female students had higher interest in chemistry respectively than their male counterparts, Okekeokosisi and Okigbo (2021) reported that there is no significant difference in the mean interest scores of male and female students in science subjects. Conscious efforts therefore need to be made to prepare these students with a view to capturing their interest and enhancing their performance in sciences (Olatoye, 2017**).** This inconclusive results on gender calls for further investigation to find out if laboratory-based learning strategy influences students' performance and interest in chemistry practical regardless of gender.

Statement of the Problem

One of the activities in chemistry is practical. It provides a forum for practicalising the theoretical knowledge gained in the classroom and for demonstrating the psychomotor skills of a teacher and learner. It further aids the understanding of difficult chemistry concepts in the curriculum; creates opportunity for the testing of facts and theories in chemistry. In an attempt to test for theories, principles and laws in chemistry, teachers employed several instructional strategies in teaching of chemistry practical but the students' performance in both internal and external examinations has been consistently due to students' poor or lack of exposure to practical activities (Ajayi, 2017a; Eze & Okorie, 2019; Ogunleye & Bamidele, 2014; Olorundare, 2014).

This emerging concern has necessitated the need for and use of activity-oriented and learner-centered strategies in which students play the most active part and interact with each other to construct their own knowledge. Hence, the need to adopt laboratory-based learning strategy which could positively influence students' interest and performance. Therefore, the problem of this study put in question form is, how laboratory- based learning strategy foster senior secondary school students' interest and academic performance in quantitative and qualitative aspect of chemistry practical in Ankpa Local Government Area of Kogi State?

Research Questions

The following research questions are raised to guide the study:

i. What is the effect of the laboratory-based learning and alternative-to practical strategy strategies on students' mean academic performance score in chemistry practical?

ii. What is the effect of the laboratory-based learning and alternative-to practical strategy strategies on students' mean interest score in chemistry practical?

iii. What is the difference in the mean performance score of male and female students taught chemistry practical using laboratory-based learning strategy?

iv. What is the difference in the mean interest score of male and female students taught chemistry practical using laboratory-based learning strategy?

Research Hypotheses

The following null hypotheses are formulated and tested at 0.05 level of significance:

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HO_1: There is no significant difference between the mean academic performance score of senior secondary students taught chemistry practical using laboratory-based learning strategy and those taught using alternative-to practical strategy.
HO_2: There is no significant difference between the mean interest score of senior secondary students taught chemistry practical using laboratory-based learning strategy and those taught using alternative-to practical strategy.
HO_3: There is no significant difference between the mean performance score of male and female students taught chemistry practical using laboratory-based learning strategy.
HO_4: There is no significant difference between the mean interest score of male and female students taught chemistry practical using laboratory-based learning strategy.

Research Methodology

The study adopted a pretest-posttest non-equivalent quasi-experimental design. The study was carried out in Ankpa metropolis in Kogi State. The target population for the study was made up of 3,621 Senior Secondary Schools II chemistry students in all 57 coeducation secondary schools in Ankpa Education Zone of Kogi State. The sample of this study comprised of 184 students (96 females and 88 males) SSS II from two intact schools using purposive sampling technique. The schools were randomly assigned to experimental and control groups in a manner that each of the schools has equal and independent chance of been included in the study. The criteria for the selection of schools include: The schools were government co-educational approved schools with functional chemistry laboratory, conducive school environment, WAEC and NECO approved centres for not less than ten years, qualified teachers with first degree in chemistry and with at least 5 years of teaching experience.

Two instruments were developed by the researcher and used for data collection. The instruments were Qualitative and Quantitative Analyses Achievement Test (QQAAT) and Qualitative and Quantitative Analyses Interest Inventory (QQAAII). QQAAT was a 50-item multiple choice questions with option A-D drawn from past West African Examination Council and Unified Tertiary Matriculation Examination questions on qualitative and quantitative analyses concept of chemistry practical, designed to assess students' achievement of knowledge gained during the experimentation. QQAAII was 50 items designed to determine students' interest in qualitative and quantitative analyses concept of chemistry practical which was rated on using a four-point Likert-type scale of Strongly Agree (SA) = 4 points, Agree (A) = 3 points, Disagree (D) = 2 points and Strongly Disagree (SD) = 1 point. The QQAAT and QQAAII were subjected to face and content validation by three experts drawn from department of curriculum studies, department of chemistry and measurement and evaluation, Kogi State College of Education Ankpa. Based on the comments and suggestions from the experts, corrections and modifications were made on the instruments. The instruments were pilot tested. A reliability coefficient of 0.89 was obtained for QQAAT using K-R_{21} and 0.92 for QQAAII using Cronbach Alpha, implying that the instruments were reliable enough for the study.

The subject teachers in the selected schools were trained as research assistants on the use laboratory-based learning strategy using validated lesson packages on qualitative and quantitative analyses concept of chemistry practical developed by the researcher. Treatment

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was assigned to one experimental group (Laboratory-based learning strategy) and one control group (Alternative- to- practical strategy). Each group was taught qualitative and quantitative analyses concept of chemistry practical. This topic was broken into twelve (12) teaching lessons. Each lesson was taught within two (2) periods of 40 minutes each per week. The experiment lasted for twelve weeks. Afterwards, the QQAAT and QQAAII were administered to the students as a pre-test to each group. After, the reshuffled versions of QQAAT and QQAAII were administered by the research assistants as post-test. An attempt was made to control and minimize the effects of extraneous variables in the course of data collection. Data collected were analyzed with the help of Statistical Package for Social Science (SPSS) software (version 21). On SPSS, the research questions were analyzed using mean and standard deviation while the hypotheses were tested using Analysis of Covariance (ANCOVA) at 0.05 level of significance with the pre-test scores as a covariate.

Results

Research Question One: What is the effect of the laboratory- based learning and alternative-to practical strategy strategies on students' mean performance score in chemistry practical?

Table 1: Mean and Standard Deviation of Academic Performance of Students Exposed to Laboratory-Based Learning and Alternative-to-Practical Strategies.

Treatment Groups	N	Pre-test		Post-test		Mean Gain
		Mean	SD	Mean	SD	
Laboratory-Based Learning	108	19.97	4.53	73.52	12.99	53.55
Alternative-to-Practical	76	18.80	4.67	34.50	15.70	15.70

Source: Field Study, 2023: N= Number of Student and SD= Standard Deviation.

Data in Table 1 show that the performance gain mean scores of students exposed to laboratory-based learning strategy is 53.55 is higher than that of alternative-to-practical strategy of 15.70. This is an indication that, students taught qualitative and quantitative analyses using laboratory-based learning strategy performed better than those who were exposed to alternative-to-practical strategy. The statistically significant difference between the mean scores of students exposed to laboratory based learning and alternative-to-practical strategies are examined by testing the hypothesis one.

Research Hypothesis One: There is no significant difference between the mean performance score of senior secondary students taught chemistry practical using laboratory-based learning strategy and those taught using alternative-to practical strategy.

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Table 2: ANCOVA Test of Statistically Significant Difference in the Performance Mean Scores of Students Exposed to Laboratory-Based Learning and Alternative-to-Practical Learning Strategies.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	η2
Corrected Model	79908.502a	2	39954.251	827.832	.000	.901
Intercept	3733.014	1	3733.014	77.346	.000	.299
Pretest	11994.226	1	11994.226	248.514	.000	.579
Group	59941.757	1	59941.757	1241.963	.000	.873
Error	8735.737	181	48.264			
Total	694926.000	184				
Corrected Total	88644.239	183				

a. Squared=.901(Adjusted Squared=.900) P<0.05.

Table 2 reveals that the ANCOVA test significance of 0.00 is less than P-value of 0.05 which implies that hypothesis one is therefore rejected. This means that, there is significant difference between the mean achievement score of senior secondary students taught chemistry practical using laboratory-based learning strategy and those taught using alternative-to practical strategy. This favour the laboratory-based learning strategy group with the mean gain of 53.55 compared to 15.70 mean gain of alternative to-practical learning strategy.

Research Hypothesis Two: What is the effect of the laboratory- based learning and alternative-to practical strategy strategies on students' mean interest score in chemistry practical?

Table 3: Mean and Standard Deviation of Interest of Students Exposed to Laboratory-based Learning and Alternative-to-Practical Strategies

Treatment Groups	N	Pre-Interest		Post-Interest		Mean Gain
		Mean	SD	Mean	SD	
Laboratory-Based Learning	108	1.49	7.17	3.78	2.29	2.29
Alternative-to-Practical	76	1.48	3.31	2.16	1.71	0.68

Source: Field Study, 2023

The results presented in Table 3 show that the interest mean gain score of students exposed to laboratory-based learning strategy is 2.29 and those exposed to alternative-to practical strategy is 0.68. This implies that students exposed to laboratory-based learning strategy developed more interest than those exposed to alternative-to practical strategy. The statistically significant difference between the interest mean scores of students exposed to laboratory-based learning strategy and alternative-to practical strategy groups are examined by testing the hypothesis two.

Research Hypothesis Two: There is no significant difference between the mean interest score of senior secondary students taught chemistry practical using laboratory-based learning strategy and those taught using alternative-to practical strategy.

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Table 4: ANCOVA Test of Statistically Significant Difference in the Interest Mean Scores of Students Exposed to Laboratory-based learning and Alternative-to Practical Strategies.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	η2
Corrected Model	33.094a	2	16.547	61.933	.000	.725
Intercept	14.384	1	14.384	53.838	.000	.534
Pre-Interest	0.483	1	0.483	1.809	.185	.037
Group	32.492	1	32.492	121.611	.000	.721
Error	12.557	47	.267			
Total	486.578	50				
Corrected Total	45.652	40				

a. R Squared = .725 (Adjusted R Squared = .713) P< 0.05.

Table 4 reveals that the ANCOVA test significance of 0.00 is less than P-value of 0.05 which implies that hypothesis two is therefore rejected. This means that, there a statistically significant difference in the interest mean scores of students exposed to laboratory-based learning strategy and alternative-to-practical strategy. This favour the laboratory-based learning strategy groups with the interest mean gain of 2.29 compared to 0.68 interest mean gain of alternative-to-practical strategy group.

Research Question three: What is the difference in the mean achievement score of male and female students taught chemistry practical using laboratory-based learning strategy?

Table 5: Mean and Standard Deviation of Academic Performance of Male and Female Students Exposed to Chemistry Practical using Laboratory-Based learning Strategy.

Treatment Group	Gender	N	Pre-test		Post-test		Mean Gain
			Mean	SD	Mean	SD	
Laboratory-Based Learning	Male	43	17.86	3.43	69.05	12.06	51.19
	Female	65	18.81	4.42	70.62	12.46	51.81

Source: Field Study, 2023

Table 5 shows that achievement mean gain of male and female students exposed to laboratory-based learning strategy are 51.19 and 51.81 respectively. This implies that, the academic performance of male and female students exposed to laboratory-based learning strategy is at par. The statistically significant difference between the mean scores of male students and female students exposed to laboratory-based learning is examined by testing the hypothesis three.

Research Hypothesis Three: There is no significant difference between the mean performance score of male and female students taught chemistry practical using laboratory-based learning strategy.

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Table 6: ANCOVA Test of Statistically Significant Difference in the Performance Mean Scores of Male and Female Students Taught Chemistry Practical using Laboratory-Based Learning Strategy

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	η2
Corrected Model	6870.415a	2	3435.207	39.349	.000	.428
Intercept	2584.480	1	2584.480	29.604	.000	.220
Pretest	6828.271	1	6828.271	78.215	.000	.427
Gender	23.814	1	23.841	.273	.602	.003
Error	9166.660	105	87.302			
Total	546638.000	108				
Corrected Total	16037.074	107				

a. Squared=.428(Adjusted Squared= .418) P>0.05.

Table 6 reveals that the ANCOVA test significance of 0.602 is greater than P-value of 0.05 which implies that hypothesis three is therefore retained. This implies that, there is no statistically significant difference in the performance means scores of male and female students taught chemistry practical using laboratory-based learning strategy.

Research Question three: What is the difference in the mean interest score of male and female students taught chemistry practical using laboratory-based learning strategy?

Table 7: Mean and Standard Deviation of Interest Mean Scores of Male and Female Students Exposed to Chemistry Practical using Laboratory-Based learning Strategy.

Treatment Group	Gender	N	Pre-Interest		Post-Interest		Mean Gain
			Mean	SD	Mean	SD	
Laboratory-Based Learning	Male	43	1.49	3.32	3.76	7.20	2.27
	Female	65	1.52	3.42	3.76	7.27	2.24

Table 7 shows that interest mean gain of male and female students exposed to laboratory-based learning strategy are 2.27 and 2.24 respectively. This implies that the interest mean gain of male and female students exposed to laboratory-based learning strategy is almost at par. The statistically significant difference between the interest mean gain of male and female students exposed to laboratory-based learning strategy is examined by testing the hypothesis four.

Research Hypothesis Four: There is no significant difference between the mean interest score of male and female students taught chemistry practical using laboratory-based learning strategy.

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Table 8: ANCOVA test of Statistically Significant Difference in the Interest Mean Scores of Male and Female Students taught Chemistry Practical using Laboratory-Based Learning Strategy.

Source	Type III Sum Squares	df	Mean Squa	F	Sig.	η^2
Corrected Moc	.674a	2	.337	.647	.528	.027
Intercept	42.514	1	42.514	81.641	.000	.635
Pre-interest	.668	1	.668	1.283	.263	.027
Gender	.010	1	.010	.020	.889	.000
Error	24.475	47	.521			
Total	734.211	50				
Corrected Tota	25.149	49				

a. R Squared = .027 (Adjusted R Squared = -.015) P>0.05

Table 8 reveals that the ANCOVA test significance of 0.889 is greater than P-value of 0.05 which implies that hypothesis four is therefore retained. This implies that, there is no statistically significant difference in the mean interest scores of male and female students exposed to laboratory-based learning strategy.

Discussion of the Findings

This study was carried out with the aim of fostering students' interest and academic performance in quantitative and qualitative of chemistry practical through laboratory –based strategy in secondary schools in Ankpa Local Government Area of Kogi State. Results presented in Tables 1 and 2 have shown that performance of students exposed to laboratory-based learning strategy and their counterparts exposed alternative-to-practical strategy was statistically significant. The findings revealed that laboratory-based learning strategy was more effective in fostering students' academic performance in chemistry practical. This result corroborated several studies (e.g., Abakpa *et al*. 2016; Odutuyi, 2016; Ezeano & Ugwu, 2018; Chibabi *et al*., 2018; Usman, 2018; James *et al*., 2019; Walter, 2021; Jitzi, 2019; Abbey and Vikoo, 2019; Afolabi, 2021; Ntawuhiganayo & Nsanganwimana, 2022) which provided empirical evidences on the effectiveness of laboratory-based learning strategy in enhancing students' achievement in general. The higher academic performance by laboratory-based leaching strategy may be due to the active participation of all the students at every stage of the practical activities.

Also, academic performance of male and female students taught chemistry practical using laboratory-based learning strategy was not statistically significant (see Tables 5 and 6). This implies that laboratory-based leaching strategy is a gender unbiased. This is due to the fact that laboratory-based learning strategy helps male and female students to collaborate and gain from one another in the learning process. The finding is in consonance with the findings of Ezeano and Ugwu (2018); Walter (2021); Jitzi (2019); James *et al*. (2019); Afolabi (2021); Abbey and Vikoo (2019) who found laboratory-based learning strategy to be gender friendly.

More so, result in Tables 3 and 4 shows that, interest of students exposed to laboratory-based learning strategy and their counterparts exposed alternative-to-practical strategy was statistically significant. The findings revealed that laboratory-based learning strategy fostered students' interest. The findings of this study are consistent with findings of Luketic and Dolan (2013) who assert that practical activities foster positive interest in science. The

findings of this study are equally consistent with findings Afolabi (2021) who revealed that students taught using the laboratory strategy had more interest in chemistry. On influence of gender, the study revealed that interest of male and female students taught chemistry practical using laboratory-based learning strategy was not statistically significant (Tables 7 and 8). This indicates that laboratory-based leaching strategy fostered male and female students' interest equally. The findings of this study are consistent with findings of Okekeokosisi and Okigbo (2021) who reported that there is no significant difference in the mean interest scores of male and female students in science subjects.

Conclusion of the Study

Based on the findings of this study, it is hereby concluded that laboratory-based learning strategy fostered students' interest and academic performance in quantitative and qualitative analyses of chemistry practical. In addition, there was no statistically significant difference in the mean performance and interest of male and female students exposed to laboratory-based learning strategy. This means that, laboratory-based learning strategy has the potency to positively foster interest and performance of students irrespective of gender. This is an indication males and females benefited significantly from the laboratory learning strategy since it is activity oriented which made them engage in in-depth critical thinking and process skills.

Recommendations

i. Curriculum planners should incorporate and emphasize the use of laboratory-based learning strategy in the teaching of chemistry practical.
ii. Chemistry teachers should be encouraged to use laboratory-based learning strategy in teaching senior secondary school chemistry practical.
iii. Federal and State Ministries of Education and relevant professional associations should organize workshops for teachers to update their teaching methodology on the implementation of laboratory-based learning strategy for practical instruction.
iv. Gender-based innovative strategies should be considered when selecting instructional strategy for teaching and learning of chemistry practical and science in general.

Conflict of interests

The authors have not declared any conflict of interests

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