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EFFECT OF LEARNING APPROACHES ON ACADEMIC PERFORMANCE OF CHEMISTRY STUDENTS IN SENIOR SECONDARY SCHOOL IN AWKA SOUTH LOCAL GOVERNMENT AREA.

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ABSTRACT

The study investigated the effect of learning approaches on academic performance of chemistry students in senior secondary school in awka south local government area. Two research questions guided the study and two hypotheses were tested at 0.05 alpha level of significance. Quasi-experimental design was adopted, specifically the pre test-post test non-randomized control group design was used. The population of the study comprised 1956 senior secondary two (SS2) students offering chemistry in Awka south LGA, from which 147 students involved in the study were drawn using purposive sampling techniques. The instrument for data collection was Chemistry Performance Test (CPT) validated by two experts from the Departments of Science Education and one from Educational Foundations, Nnamdi Azikiwe University, Awka. The reliability of CPT was established using Kuder-Richardson Formula 20 which yielded a coefficient of internal consistency of 0.78. Research questions were answered using mean and standard deviation where as analysis of covariance (ANCOVA) was used to test the null hypotheses. The findings showed that; students taught chemistry using PBL and IBL had higher mean achievements cores than those taught using lecture method and the observed difference in their mean score was significant. Gender also had no significant influence on students' academic performance in chemistry. It was recommended among others that chemistry teachers should teach chemistry using PBL and IBL approaches among others.

Keywords: Effect, learning approaches, academic performance, chemistry students, senior secondary school.

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Introduction

In the field of science education, there has been a great concern globally and especially in developing countries about the role and effectiveness of the teaching of science in schools at all levels. In the last few decades, this concern has resulted in a number of significant developments both in methods of teaching and in content and structure of the curriculum of science. In respect to this, Okeke (2018) defined science education as an integrated field of study that considers the subjects of science discipline as well as the processes involved in the teaching and learning of science.

Science education comprises the basic disciplines such as biology, chemistry, physics and mathematics. The Federal Ministry of Education (FME, 2017) identified chemistry among the core-science subjects offered at the Senior School Certificate Examination (SSCE) level. Chemistry results in most certified examinations like, Senior School Certificate Examination (SSCE) conducted by both the West African Examinations Council (WAEC) and the National Examinations Council (NECO) have not been satisfactory in Nigeria (WAEC, 2018, 2019, 2020, 2021). In 2018, with an enrolled number of 728,998 students, the performances of the students were below average. From 2019 to 2021, similar trend of fluctuating academic performances have been observed with more than 40% having below credit among students who enrolled for chemistry in WASSCE. The observed decline in students' performance in SSCE chemistry may not be unrelated to their perception of difficulties in understanding certain areas of chemistry which are regarded as complex and abstract e.g. organic chemistry, electrochemistry, chemical reaction, electrolysis etc. As a result, the students tend to dislike this topic in chemistry hence the tendency to avoid this area during examinations.

Chemistry according to Nnoli and Samuel (2023) is the study of the composition, properties, structures, interactions, and transformation of matter, either in isolation or combination. As a school subject, chemistry involves studying natural and artificially produced substances, their composition, their reactions and interactions, their effects on humans and the environment. Chemistry as a subject is concerned with the substances of which matter is

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Volume 07 || Issue 09|| September, 2024 ||

composed, the investigation of their properties and reactions, and the use of such reactions to form new substances and as such is a skilled subject or course which tends to harness its usefulness thus explaining its importance. The subject (chemistry) becomes completely beneficial when students are able to comprehend and assimilate the subject matter by adopting the various learning approaches that will affect their performance positively. These approaches are been referred to as innovative approaches in learning. They range from teacher-centered approaches like lectures and demonstrations to student-centered approach like group work, inquiry, and problem-solving , Nnoli (2024).

Lecture method is a teaching method in which the teacher gives out information to students who are at receiving end. It is therefore teacher-centered. The advantage is that it can accommodate large number of students at a time but itdoes not stimulate students "innovation, inquiry and scientific method (Konyefaand Okigbo, 2021). There is therefore the need for an innovative teaching methods such as: jigsaw approach, cooperative learning approach, problem-based learning approach, inquiry-based learning approach etc., that will promote excellence, motivate students to learn, give at rans formative educational experience. The innovative learning approach considered in this research is Problem-based learning approach and Inquiry-based learning approach.

Problem -based learning approach according to Barrows in (Iroanya 2020), is student-centric and begins with a real or replicated problem that attempts to stimulate students to solve the problem through the development of positive skills and attitudes as well as critical thinking, and to look for more consistent and long-lasting knowledge on the research theme, that is the problem. Hung (2009) posited that the design of problems which he developed as **"3C3R"** is crucial in and assisting the teacher and students to effectively make use of problem-based learning approach. The 3Cs represent content, context and connection, while the 3Rs comprise researching, reasoning, and reflecting, which support the cognitive processes of problem-solving skills and self -directed learning. Students and the teacher identify resources to research learning issues. The students' coming together again, integrating their new knowledge into the context of the problem, and continue to define new learning issues as they progress through the problem. This

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Volume 07 || Issue 09|| September, 2024 ||

approach is recommended by Kanet and Barut sited in (Iroanya 2020) as it provide an ample opportunity for students to develop critical-analytic reasoning capability that will motivate them to be active agents in the learning process as becoming chemistry graduates.

Inquiry-Based learning approach which is the other learning approach used in this work is said according to Olorode (2016), to be an instructional method that emphasizes students' active involvement in the learning process and enables them to think together with a view to discovering knowledge under the guidance of the teacher. This approach is student-centred and an activity-oriented approach which allows the chemistry teacher to use varieties of instructional materials and probing questions, to enable students discover answers to chemistry problems. Adopting inquiry-based approach in practical courses such as chemistry, Bicknell, Holmes and Hoffman in Iroanya (2020) explained that learning is active rather than passive; learning is activity-based and process-oriented rather than content-oriented while failure is important for future success; feedback is necessary for control measures and deeper understanding is ensured. Accordingly, Olorode and Jimoh (2016) opined that inquiry based approach is learner-centred, democratic and interactive. It improves the academic performance of students in chemistry as they are able to reason, discover facts and develop self-confidence in solving chemistry problems.

Moreover, Aminu (2019) has shown that despite the emphasis on innovative approach to the teaching of chemistry, chemistry is still taught with traditional methods. This traditional method which is also referred to as lecture method are often used by chemistry teachers as it en ables them to cover large portions of the scheme of works especially for the over-populated classroom common in public schools. The concept of performance is general to all fields of human endeavour. However, the students' potential is related to his or her actual performance through learning.

Academic performance is therefore viewed as the level of performance in a particular field of study such as chemistry (education) (Mweti, 2013). Ige (2016), posited that academic

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JULIANA NKIRU NNOLI*

Volume 07 || Issue 09|| September, 2024 ||

performance is the scholastic standing of a student at a given moment. This scholastic standing could be explained in terms of the grades obtained in a subject or group of subjects at the end of an examination. Based on the definitions of academic performance, it is safe to say that students' performance in chemistry is also dependent on the learning approaches adopted.

With a list of varying learning approaches, two of which are problem-based learning and inquiry based learning approaches, are used in this study because both are slightly familiar as one leads to another. Both approaches are learning approaches that may facilitate students' learning in scientific concepts and about the nature of chemistry through experimental research, allowing them to participate in chemistry classes as researchers. In the context of the background to the study regarding to this research, the researcher seeks to explore problem-based learning and inquiry based learning approaches to the teaching and learning of chemistry in our secondary schools in Anambra State (Awka South L.G.A)

Statement of the Problem

The academic performance of every student majorly depends on the type of learning approach employed by the teacher during teaching and learning process. Consequently, the teaching strategy adopted in our schools seems not fully effective especially on subjects such as chemistry. For instance, the use of lecture and memorization strategy which is teacher-centred only has been often used in teaching of this subject in some of our secondary schools in Nigeria as observed by the researcher. In this regard, students' performance has seen to be deteriorated in the subject. Chemistry as a specialized subject involves skills that cannot be mastered by mere lecture method and memorization of basic rules. In spite of the importance of chemistry, its teaching and learning posed many challenges for both the teacher and students resulting in poor performances of students in the subject. The need to further improve in the performance of students in chemistry is shown in the students "performance in external examinations such as West African Examination Council (WAEC).

In order to find a lasting solution to this existing problem, it becomes imperative to identify various learning approaches which can help students achieve better in their academics. This

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https://ijojournals.com/

Volume 07 || Issue 09|| September, 2024 ||

study therefore explores problem-based learning and inquiry based learning approaches to the learning of chemistry in our secondary schools in Anambra State (Awka South L.G.A).

Purpose of the Study

The purpose of this study is to determinethe effect of learning approaches on academic performance of chemistry students in senior secondary schools in Awka South Local Government Area, Anambra State. Specifically, this study sought to;

1. Determine the difference in the mean performance scores of students taught chemistry with problem-based learning (PBL) and those taught with lecture method in senior secondary schools in Awka South L.G.A, Anambra State.

2. Determine the difference in the mean performance scores of students taught chemistry with inquiry-based learning (IBL) and those taught with lecture method in senior secondary schools in Awka South L.G.A., Anambra State.

Research Questions

The following research questions guided this study;

1. What is the difference in the mean performance scores of students taught using problem-based learning and those taught using lecture method in chemistry?

2. What is the difference in the mean performance scores of students taught using Inquiry-based learning and those taught using lecture method in chemistry?

Research Hypotheses

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

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Ho_1: There is no significant difference in the mean performance scores of students taught using Problem-based learning approach and those taught using lecture method in chemistry in senior secondary schools.

Ho_2: There is no significant difference in the mean performance scores of students taught using Inquiry-based learning approach and those taught using lecture method in chemistry in senior secondary schools.

Methods

The research design used for this study is quasi experimental research design. Specifically, non-equivalent control group design was used. Quasi-experimental research design is a design where random assignment of subjects to experimental and control group is not possible (Nworgu, 2015). Hence, complete randomization of subjects in group was not possible but intact classes were used. The choice of the quasi experimental design is because some schools may not allow disruption and manipulation of their classes. The area of the study was Awka South Local Government Area in Awka Education Zone of Anambra State. The population of the study consists of all the 1956 senior secondary school two (SS 2) chemistry students in the nineteen public secondary schools in Awka South Local Government Area in Anambra State. The sample of this study consists of 147 SS 2 chemistry students drawn from three schools out of the 19 public secondary schools in Awka South L.G.A of Anambra State. The first Experimental group was made up of 49 students (22 males and 27 females) while the second experimental group was made up of 50 students (27males and 23 females) and the control group was made up of 48 students (20 males and 28 females). The Instrument which is the chemistry performance test was used for data collection.

The face and content validation of the instruments were done by three experts and was subjected to reliability. The reliability coefficient of the instrument was found to be 0.78 which confirmed the reliability of the instrument. Mean and standard deviation were used to answer the research questions while analysis of covariance (ANCOVA) was used in testing the hypotheses at ban alpha level of 0.05.

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Results

Research Question 1

What is the difference in the mean performance scores of students taught chemistry using problem-based learning and those taught using lecture method?

Table 1: Mean performance scores of students taught chemistry using problem-based learning and those taught using lecture method.

	Pre-test			Post-test				
Teaching method	**N**	**Mean**	**SD**	**N**	**Mean**	**SD**	**Mean Gain**	**Mean difference**
PBL	49	22.45	6.288	49	65.67	14.942	43.22	6.43
Lecture	48	24.21	5.206	48	61.00	11.246	36.79	-6.43

From the data in Table 1, it was observed that students taught chemistry using problem-based learning (PBL) had a higher mean performance score in the post-test (65.67) compared to those taught using the lecture method (Lecture), with a post-test mean score of 61. Despite starting with a lower pre-test mean score (22.45) than the Lecture group (24.21), the PBL group showed a significant improvement, achieving a mean gain of 43.22 compared to the Lecture group's mean gain of 36.79. The positive mean difference for the PBL group (6.43) and negative mean difference for the Lecture group (-6.43) suggest that problem-based learning is more effective in enhancing students' academic performance in chemistry.

Research Question 2

What is the difference in the mean performance scores of students taught using Inquiry-based learning and those taught using lecture method in chemistry?

Table 2: Mean performance scores of students taught using Inquiry-based learning and those taught using lecture method in chemistry.

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Teaching method	Pre-test			Post-test			Mean Gain	Mean difference
	N	Mean	SD	N	Mean	SD		
IBL	50	24.72	5.326	50	70.6	10.437	45.88	9.09
Lecture	48	24.21	5.206	48	61	11.246	36.79	-9.09

In Table 2, it was observed that students taught chemistry using inquiry-based learning(IBL) had a higher mean performance score in the post-test (70.6) compared to those taught using the lecture method (Lecture), who had a post-test mean score of 61. Both groups started with similar pre-test scores, with the inquiry-based learning group at 24.72 and the Lecture group at 24.21. However, the inquiry-based learning group showed a more substantial improvement, achieving a mean gain of 45.88 compared to the Lecture group's mean gain of 36.79. The positive mean difference for the inquiry-based learning group (9.09) and negative mean difference for the Lecture group (-9.09) suggest that inquiry-based learning is more effective in enhancing students' academic performance in chemistry.

Hypothesis

Hypothesis 1: There is no significant difference in the mean performance scores of students taught using Problem-based learning approach and those taught using lecture method in chemistry in senior secondary schools.

Table 3: Summary of Analysis of Covariance of Student Mean performance scores of students taught using Problem-based learning approach and those taught using lecture method in chemistry in senior secondary schools.

Sources of Variation	SS	Df	MS	*F*	*p*-value	Decision
Intercept	6535.568	1	6535.568	51.224	0.000	
Pretest	4595.264	1	4595.264	36.017	0.000	
Technique	2116.168	1	2116.168	16.586	0.000	Significant
Error	11993.18	94	127.587			
Total	25240.18	97				

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An Analysis of Covariance (ANCOVA) was conducted to determine the effect of the teaching technique on students' mean performance scores in Chemistry, presented in Table 5 above. The results revealed that there was a statistically significant effect of the teaching technique on the students' academic performance scores, F(1, 94) = 16.586, p = 0.000. Since the p-value was less than 0.05, the null hypothesis was rejected. Hence, there is a significant difference in the mean performance scores of students taught using the Problem-based learning approach and those taught using the lecture method in chemistry in senior secondary schools.

Hypothesis 2

There is no significant difference in the mean performance scores of students taught using Inquiry-based learning approach and those taught using lecture method in chemistry in senior secondary schools.

Table 4: Summary of Analysis of Covariance of Student Mean performance scores of students taught using Inquiry-based learning approach and those taught using lecture method in chemistry in senior secondary schools.

Sources of Variation	SS	Df	MS	*F*	*p*-value	Decision
Intercept	5352.031	1	5352.031	70.096	0.000	
Pretest	3956.164	1	3956.164	51.814	0.000	
Technique	3391.883	1	3391.883	44.424	0.000	Significant
Error	7253.503	95	76.353			
Total	19953.58	98				

An Analysis of Covariance (ANCOVA) was conducted to determine the effect of the teaching technique on students' mean performance scores in Chemistry presented in table 6 above. The results revealed that there was a statistically significant effect of the teaching technique on the students' academic performance scores, F(1, 95) = 44.424, p = 0.000. Since the p-value was less than 0.05, the null hypothesis was rejected. Hence, there is a significant difference in the mean performance scores of students taught using the Inquiry-based learning approach and those taught using the lecture method in chemistry in senior secondary schools.

Discussion

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The findings from the study indicate that problem-based learning (PBL) is more effective in enhancing students' academic performance in chemistry than the lecture method**.** It also shows a statistical significant difference in the mean academic performance scores of students taught using the Problem-based learning approach and those taught using the lecture method in chemistry in senior secondary schools. Hence, there is a significant difference in the mean performance scores of students taught using the Problem-based learning approach and those taught using the lecture method in chemistry in senior secondary schools. This result aligns with the study byIfeoma, Zephrinus and Stephen (2022)which demonstrated that students engaged in problem-based learning showed higher academic performance and better problem-solving skills compared to those taught through traditional lecture methods

The findings from the study indicate that inquiry-based learning (IBL) is more effective in enhancing students' academic performance in chemistry compared to the lecture method. Hence, there is a significant difference in the mean performance scores of students taught using the Inquiry-based learning approach and those taught using the lecture method in chemistry in senior secondary schools. This outcome aligns with the research conducted by Adejo (2015), which highlighted that students engaged in inquiry-based learning approaches demonstrated higher academic performance and a better understanding of scientific concepts. Similarly, a study by Elaina, Angie, Cindy and Thomas (2023), supported these findings, showing that students who participated in inquiry-based learning activities performed better on assessments and developed a deeper conceptual understanding than their peers in traditional lecture-based classrooms. This suggests that the student-centered nature of IBL, which encourages exploration and critical thinking, contributes to improved academic outcomes.

Conclusion

The study concludes that Inquiry-Based Learning (IBL) is the most effective teaching strategy for enhancing students' academic performance in chemistry, promoting deeper understanding, engagement, and improved outcomes across genders. Problem-Based Learning (PBL) also proves to be more effective than lecture methods but is less effective than IBL. Lecture methods are the least effective in improving academic performance and engagement. Thus, the academic

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https://ijojournals.com/

Volume 07 || Issue 09|| September, 2024 ||

performance of students are highly dependent on the instructional approach employed, emphasizing the need for thoughtful and inclusive teaching practices to accommodate diverse learning needs.

Recommendations

From the discussion of the results, the following recommendations were made:

i. Since Inquiry-Based Learning has been empirically investigated to enhance the quality of academic achievement in chemistry, chemistry teachers should, therefore, use it in the classroom. This technique fosters active participation and collaborative learning, which are essential for understanding complex concepts in chemistry.

ii. In-service training, workshops, seminars, and symposia should be organized by the Ministry of Education and professional associations like the Curriculum Organization of Nigeria (CON) and the Science Teachers Association of Nigeria (STAN) for practicing teachers.

iii. Professional development opportunities will enable teachers to understand and effectively implement the Inquiry-Based Learning technique in their chemistry classrooms, thereby enhancing the overall quality of science education.

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Volume 07 || Issue 09|| September, 2024 ||

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https://ijojournals.com/ Volume 07 || Issue 09|| September, 2024 ||

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