

EFFECT OF LABORATORY INSTRUCTIONAL STRATEGY ON CHEMISTRY STUDENTS' PERFORMANCE AND RETENTION IN COLLEGES OF EDUCATION IN NORTH-WEST, NIGERIA

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Abstract

The study aimed to evaluate the effect of laboratory instructional strategy on chemistry students' performance and retention in colleges of education in north-west, Nigeria. The study have two objectives and corresponding research questions and hypotheses. The study employed a quasi-experimental research design with pre-test, treatment, post-test and post-post-test. The population of the study consists of 1,175 NCE II Chemistry students from federal colleges of education in north-west, Nigeria. The sample comprised 442 NCE II chemistry students from intact classes, selected through purposive sampling to ensure uniformity in background and exposure. Data collection involved the use of the Chemistry Performance and Retention Test (CPRT). The reliability coefficient for CPRT was found to be 0.969 using Pearson Product Moment Correlation Coefficient (PPMCC). Mean and standard deviation were utilized to analyze the research questions, paired sample t-test was employed to test the hypotheses. The findings revealed significant positive effects of laboratory instructional strategy on performance and retention of chemistry students in colleges of education in north-west, Nigeria. In light of these findings, the study recommended for a curriculum review by National Commission for Colleges of Education (NCCE) to accommodate the evolving dynamics of laboratory applications in tertiary institutions. This adjustment aims to foster students' autonomy in knowledge acquisition and promote self-discovery learning, aligning with modern educational paradigms.

Keywords: Laboratory Instructional Strategy, Chemistry, Performance and Retention.

Introduction

The aim to improve student performance and enhance retention rates has sparked a growing interest in the efficacy of instructional strategy. Recent years have witnessed a heightened awareness of the intricacies of the teaching-learning process, driving educators to delve deeper into understanding how learners acquire knowledge. Danjuma (2021) emphasises that science, including chemistry, serves as a mechanism for problem-solving aimed at elevating human living standards. Alake (2015) observed that the economic and political strength of a nation is always assessed in terms of its achievements in science and technology.

All kinds of matter are made up of atoms and molecules, and chemistry is a fundamental science field that studies the makeup, structure, and behaviour of these building blocks of

matter. Chemistry is the link between many other human pursuits, including home, agriculture, health, industry, and the other sciences. The different operational methods for production in the manufacturing, engineering, and capital goods industries were all based on chemistry. The significance of chemistry in science is highlighted by its integration with other scientific disciplines. Chemistry intersects with biology in the field of biochemistry and with physics in the realm of physical chemistry. Since chemistry is essential to many scientific domains in which humans are interested, it is important to give chemistry education a high priority and employ student-centred teaching strategies that engage students in the process of learning.

Given the significance of chemistry education, it is crucial to carefully choose teaching methods that effectively deliver the chemistry curriculum in colleges of education across Nigeria. There are varieties of teaching methods for lecturers in colleges of education, depending on the situation, and there are also many methods that are lecturer-focused or student-centred, ranging from instruction, role-playing, projects, discovery, and so on. A good and effective teaching strategy leads to the achievement of instructional objectives. Thus, the laboratory strategy if properly implemented, could prove effective in facilitating the teaching and learning process of chemistry in colleges of education.

The laboratory strategy stands out as a unique approach to instruction, forming an integral part of effective science teaching. In this strategy, the teacher avoids relying solely on lectures or demonstrations of experiments. Instead, students are empowered to discover scientific laws and principles by actively engaging in experiments. Equipped with the necessary materials and instructions, students conduct experiments independently, recording observations and drawing conclusions from the results they obtain (Alake, 2015).

The laboratory strategy serves as an effective teaching approach for chemistry and other science subjects in colleges of education across Nigeria. The approach may help students gain a better grasp of ideas, scientific applications, scientific attitudes, practical skills, and an understanding of how chemistry functions. It may also help them learn how to plan and carry out investigations to support scientific claims using technical know-how and lab equipment (Kwabena, 2013). This suggests that employing the laboratory strategy in teaching chemistry offers students the chance to engage in scientific practices akin to those of professional scientists.

Chemistry, as a science subject, should be fundamentally fascinating to students in an adventurous way. A method that allows students to better understand scientific concepts and grasp essential scientific skills embedded in teaching and learning chemistry involves real-life experiences that are fundamental to teaching the subject. The adoption of effective teaching strategies in the implementation of the chemistry curriculum will arouse the students' attitude and build retention levels, which will positively impact the students' academic performance.

Statement of the Problem

The researcher noted that the conventional teaching strategy employed for NCE students in chemistry was insufficient to cover the curriculum adequately due to limited time allocated for practical exercises. This limitation arises from the large class sizes and inadequate availability of reagents for practical work. Yusuf and Umar (2019) reported that inadequate laboratory

facilities are responsible for student's poor performance. As a result, students lack scientific problem-solving skills, scientific inquiry skills, the acquisition of scientific knowledge, exposure to scientific research environments, and poor performance in chemistry practical.

Objectives of the Study

The study was carried out using the following objectives to:

1. examine the effect of laboratory instructional strategy on the performance of chemistry students in colleges of education north-west, Nigeria.
2. ascertain the performance and retention level of chemistry students taught using laboratory instructional strategy in colleges of education north-west, Nigeria.

Research Questions

The following research questions guided the study:

1. What is the effect of laboratory instructional strategy on the performance of chemistry students in colleges of education north-west, Nigeria?
2. What is the performance and retention level of chemistry students taught using laboratory instructional strategy in colleges of education north-west Nigeria?

Hypotheses

The following null hypotheses guided the study:

- Ho₁. There is no significant difference between the performance of chemistry students taught using laboratory instructional strategy in colleges of education north-west, Nigeria.
- Ho₂. There is no significant difference in the performance and retention level of chemistry students taught using laboratory instructional strategy in colleges of education north-west, Nigeria.

Methodology

The research design employed in this study is quasi-experimental design involves pre-test, post-test, and post-post-test measures of nonequivalent groups with intact classes. The study's population comprises 46 NCE II chemistry students in federal colleges of education (TECH) Bichi located in the North-west of Nigeria. 46 intact class students were purposively selected as sample.

The instrument used to gather data for the study was Chemistry Students Performance and Retention Test (CPRT). The instrument consisted fifty (50) multiple-choice objective assessment items based on the Chemistry concepts taught from NCE II chemistry curriculum. The students were made to select the correct answers from four lettered options A-D, chemistry topics that were taught include: composition of soil and water, environmental pollution, environmental pollution (air, water and soil) and solubility of substance as contained in Nigeria Commission for Colleges of Education Chemistry curriculum (NCCE). CPRT was validated by experts from the Department of Educational Foundations and Curriculum, Faculty of Education, Ahmadu Bello University, Zaria, as well as experts from the field of Science Education at Federal College of Education, Zaria. The laboratory activities (treatment) session

spanned a duration of ten weeks. Meanwhile, the control group underwent traditional lecture-based instruction on the same content covered by the experimental groups. The collected data underwent rigorous statistical analysis using the Statistical Package for the Social Sciences (SPSS). Mean and standard deviation were computed to address the research questions. Hypotheses were tested through paired sample t-test. All statistical tests were conducted at a significance level of 0.05 alpha to ensure robust findings.

Results

Research Question One: What is the effect of laboratory instructional strategy on the performance of chemistry students in colleges of education north-west, Nigeria?

Table 1: Mean and standard deviation on effect of laboratory instructional strategy on the performance of chemistry student in colleges of education

Variables	Mean	SD	Mean diff.
Pre-test	23.83	7.87	
			17.58
Post-test	41.41	6.00	

Table 1 showed the performance of chemistry students taught using laboratory instructional strategy in colleges of education north-west. The result revealed mean response of 23.83 for pretest and 41.41 posttest scores of students, showing a mean difference of 17.58. This indicates that laboratory teaching strategy is more effective in teaching chemistry in colleges of education north-west Nigeria, despite scoring less than the mean benchmark of 50%. While the standard deviation of 7.87 for pre-test showed that there was some variation in their pre-test scores and for post-test 6.00 is indicating that there was no variation in their scores.

Research Question two: What is the retention level of chemistry students taught using laboratory instructional strategy in colleges of education north-west, Nigeria?

Table 2: Mean and Standard deviation on performance and retention level of chemistry students taught using laboratory instructional strategy in colleges of education

Variables	N	Mean	SD	Mean diff.
Performance	46	41.41	6.00	
				2.932
Retention	46	38.478	0.935	

Table 2 showed the performance and retention levels of chemistry student taught using laboratory instructional strategy in colleges of education north-west Nigeria. The table showed that performance of chemistry student taught using laboratory teaching strategy = 41.41 and their retention = 38.478, with a mean difference of 2.932. This showed that the students' retention fell below their performance level. However, the standard deviation of 6.00 and 0.935

for performance and retention respectively is an indication that their scores are closely knitted together.

HO₁: There is no significant difference in the effect of laboratory instructional strategy on the performance of chemistry students in colleges of education north-west, Nigeria.

Table 3: Summary of paired sample t-test of chemistry students taught using laboratory instructional strategy in colleges of education north-west, Nigeria.

Variable	Mean	SD	t-cal	Df	t-crit	P-value	Decision
Pre-test	23.83	7.87	17.431	45	1.960	0.000	Rejected
Post-test	41.41	6.00					

Table 3 presents the summary of the paired sample t-test on the performance of chemistry students taught using outdoor teaching strategy. The calculated t-value was 41.894, while the critical t-value was 1.960. The corresponding p-value was determined to be 0.000, which is less than the significance level of 0.05. Therefore, the null hypothesis is rejected. This indicates that the performance of chemistry students taught using laboratory instructional strategy is significantly high.

HO₂: There is no significant difference in the performance and retention level of chemistry student taught using laboratory instructional strategy in colleges of education north-west, Nigeria.

Table 4: Summary of paired sample t-test on the performance and retention level of chemistry student taught using laboratory instructional strategy

Variable	N	Mean	SD	t-cal	Df	t-crit	P-value	Dec
Performance	46	41.413	6.006					
Retention	46	38.478	0.935	9.930	45	2.262	0.000	Rej

Table 4 presents a summary of the paired sample t-test on the performance and retention levels of chemistry students taught using laboratory instructional strategy. The table shows that the calculated t-value is 9.930, while the critical t-value is 2.262. The p-value is 0.000, which is less than the alpha value of 0.05. This implies that there was a significant difference between students' performance and their retention level. Specifically, students' performance was higher than their retention level.

Discussion of Findings

Finding indicates a significant improvement in the posttest performance of students taught chemistry using laboratory instructional strategy compared to their pretest scores. This finding aligns with previous research by Abidoye (2021), which also demonstrated positive outcomes for students instructed with laboratory methods. Similarly, Adejo (2021) found that students' posttest performance following laboratory-based instruction surpassed their pretest scores significantly. These findings collectively suggest that laboratory teaching strategy not only enhances academic performance but also motivates students to actively engage in learning activities, thereby fostering significant improvements in their retention levels.

Finding also revealed that the Students taught chemistry using laboratory teaching strategy had a low retention level. This discrepancy in findings could be attributed to the spontaneous nature of the timing, catching the students off guard. Interestingly, this finding contradicts the results of Alake (2015), where students exposed to laboratory teaching strategies achieved and retained learned concept. Similarly, Chibabi Umaru, Onah, and Itodo (2018) found that students taught chemistry through laboratory methods demonstrated higher achievement and retention. Furthermore, Yusuf and Umar (2019) affirmed that students taught chemistry using laboratory methods exhibited superior retention abilities in the subject.

Conclusion

Laboratory instructional strategy better enhanced the performance and retention of NCE students taught chemistry using strategy. The strategy-motivated students to learn the subject than those taught with conventional strategy, which propelled their attitude towards the subjects. Laboratory instructional strategy relatively produced high performance among NCE students than those taught with conventional strategy.

Recommendations

Based on the findings of the study, the following recommendations are proposed:

1. The curriculum planners should ensure that they incorporate laboratory strategy as a basic strategy of teaching in all courses at NCE level, as it will help to promote student retention in chemistry in North-west, Nigeria.
2. Seminars and workshop should be organized as to train chemistry lectures on the use of laboratory in lessons to help build strength, focus, self-esteem and endurance. So they can develop students' social skills, learning to work together with friends and peers on the subject in North-west, Nigeria.

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