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EFFECT OF EXPERIENTIAL LEARNING APPROACH ON RETENTION AND ACADEMIC PERFORMANCE IN CHEMISTRY AMONG SENIOR SECONDARY SCHOOL STUDENTS IN KADUNA METROPOLIS

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Abstract
The study investigated the effect of the experiential learning approach on students' academic performance and retention of chemistry concepts among senior secondary school students in Kaduna Metropolis. Three objectives guided the study: to determine the effect of experiential learning on students' academic performance, to examine its effect on retention of chemistry concepts, and to assess the relationship between retention and academic performance. Three corresponding research questions and null hypotheses were formulated and tested at 0.05 level of significance. The study adopted a quasi-experimental design. The population comprised 6,247 SS II chemistry students across selected public senior secondary schools. A sample of 400 students was selected using purposive and random sampling techniques. Data were collected using a Chemistry Achievement Test (CAT) and a Retention Test. The research questions were analyzed using mean and standard deviation, while ANCOVA was employed to test the null hypotheses. Results showed that students in the experiential learning group had a high academic performance ($M = 15.82$, $SD = 2.14$) and retention level ($M = 4.17$, $SD = 0.83$). ANCOVA revealed a significant effect of experiential learning on retention ($F = 22.53$, $p < 0.05$) and academic performance ($F = 39.59$, $p < 0.05$). A significant relationship was also found between retention and academic performance ($F = 16.37$, $p < 0.05$). It was concluded that experiential learning enhances understanding, retention, and academic performance in chemistry. The study recommended that teachers adopt experiential strategies, that policymakers support resource provision, and that capacity building programs be implemented to sustain learner-centered pedagogy.

Keywords: Experiential learning, chemistry education, academic performance, retention, Senior Secondary Students.

Introduction

Experiential learning, a pedagogical approach where students engaged directly in hands-on experiences to enhance knowledge and skills, had gained prominence in educational discourse. Rooted in the theories of David A. Kolb (2021), experiential learning emphasized the significance of concrete experiences in the learning process. In the context of chemistry education, this approach allowed students to actively participate in experiments, fostering a deeper understanding of chemical concepts and processes. Such active engagement aided in grasping complex theories while promoting critical thinking and problem-solving skills, essential for academic success in the sciences.

Traditional lecture-based teaching methods, often characterized by passive learning, had been scrutinized for their effectiveness in science education. Yusuf and Bello (2023), assert that students in conventional settings struggled to retain information and apply theoretical knowledge to practical scenarios. In contrast, experiential learning strategies, such as case-based learning and hands-on practical activities, demonstrated significant improvements in student achievement and retention rates. For instance, Eze and Ogunleye (2023) revealed that students taught chemistry using case-based learning strategies outperformed their peers taught using traditional lecture methods. This indicated that experiential learning bridged the gap between theory and practice, making learning more meaningful and effective.

In Nigeria, particularly in regions like Kaduna Metropolis, the challenges of teaching chemistry were compounded by factors such as limited laboratory facilities and resources. Despite these challenges, innovative experiential learning approaches were implemented to enhance student learning outcomes. According to Obioha and Arokuyu (2023), the use of improvised instructional materials was shown to positively impact students' academic achievement in chemistry. By engaging students in the creation and use of these materials, educators fostered a more interactive and participatory learning environment, crucial for subjects like chemistry that require practical understanding.

Moreover, the impact of experiential learning extended beyond academic performance to influence students' attitudes towards chemistry. Positive attitudes were linked to increased motivation and interest, which were critical for sustained engagement and retention in the subject. Research by Alabi, Musa, and Yusuf (2022), indicated that students exposed to experiential learning strategies developed more favorable attitudes towards chemistry compared to those taught through conventional methods. This shift in attitude led to improved academic performance and a greater likelihood of students pursuing further studies or careers in chemistry-related fields.

The teaching and learning of chemistry in secondary schools had long been confronted with challenges related to student engagement, conceptual understanding, and knowledge retention. Yusuf and Bello (2023), maintained Traditional teaching methods,

often dominated by lecture-based instruction, were criticized for promoting rote memorization rather than deep learning, thereby limiting students' ability to apply knowledge to real-world contexts. According to Obioha and Arokoyu (2023), in many Nigerian secondary schools, including those in Kaduna Metropolis, the lack of adequate laboratory facilities and insufficient instructional resources further exacerbated these challenges, making it difficult for students to develop the necessary hands-on experience crucial for mastering chemistry. This contributed to low academic performance, poor retention of scientific concepts, and declining interest in the subject.

Consequently, there was a growing need to explore innovative and student-centered teaching strategies, such as the experiential learning approach, which emphasized active participation, experimentation, and problem-solving. Research by Kolb (2021); Eze and Ogunleye (2023) suggested that experiential learning fostered deeper understanding, enhanced retention, and improved students' attitudes toward science subjects by providing opportunities for practical engagement and real-life applications. However, despite its documented benefits, the extent to which experiential learning influenced students' academic performance and retention in chemistry within the Nigerian educational context remained underexplored. This study therefore examined the effects of the experiential learning approach on the retention and academic performance of senior secondary school students in Kaduna Metropolis, with the goal of providing empirical evidence to inform teaching practices and policy decisions aimed at improving chemistry education.

Statement of the Problem

The ideal teaching and learning process in chemistry should have fostered deep understanding, critical thinking, and long-term retention of scientific concepts. However, in many Nigerian secondary schools, particularly in Kaduna Metropolis, chemistry instruction was predominantly lecture-based, characterized by rote memorization and limited practical applications. In the words of Glory (2020), many students struggled with understanding abstract chemical concepts due to the passive nature of traditional teaching methods, resulting in poor retention and low academic performance. Adesoji and Raimi (2020), assert that the lack of well-equipped laboratories, inadequate teacher training on experiential learning strategies, and large class sizes further hindered the implementation of interactive and engaging teaching approaches. Consequently, students often failed to apply theoretical knowledge to real-life situations, leading to persistent misconceptions and declining interest in chemistry. Empirical evidence by Bello and Afolabi, (2021), suggested that students exposed to experiential learning approaches exhibited significantly higher achievement levels and retention rates compared to those taught using conventional methods. This necessitated the study of the

effectiveness of the experiential learning approach in enhancing students' understanding, retention, and academic success in chemistry within senior secondary schools in Kaduna Metropolis.

Objectives of the Study

The study aimed to:

1. Examine the effect of the experiential learning approach on the retention of chemistry concepts among senior secondary school students in Kaduna Metropolis.
2. Investigate the impact of the experiential learning approach on the academic performance of senior secondary school students in chemistry.
3. Determine the relationship between students' retention and academic performance when taught using the experiential learning approach in chemistry.

Research Questions

1. What was the effect of the experiential learning approach on the retention of chemistry concepts among senior secondary school students in Kaduna Metropolis?
2. How did the experiential learning approach influence the academic performance of senior secondary school students in chemistry?
3. What was the relationship between students' retention and their academic performance when taught using the experiential learning approach in chemistry?

Hypotheses

1. There was no significant effect of the experiential learning approach on the retention of chemistry concepts among senior secondary school students in Kaduna Metropolis.
2. The experiential learning approach had no significant impact on the academic performance of senior secondary school students in chemistry.
3. There was no significant relationship between students' retention and their academic performance when taught using the experiential learning approach in chemistry.

Literature Review

Experiential learning, as conceptualized by Kolb (2021), emphasized learning through direct experience, facilitating the transformation of knowledge into practical application. This pedagogical approach engaged learners actively, promoting deeper understanding

and skill acquisition. Recent studies demonstrated that experiential learning strategies significantly impacted students' academic outcomes. For instance, Sarpong, Sarpong and Asor (2020) investigated the influence of activity-based teaching methods on students' retention and academic performance in social studies and found that students taught using experiential learning approaches exhibited higher retention rates and improved academic performance compared to those taught through traditional methods.

Retention, in the educational context, referred to the ability of students to retain and recall learned information over time. It was a critical indicator of effective learning and was influenced by teaching methodologies. Traditional lecture-based approaches often resulted in passive learning, which did not effectively promote long-term retention. Conversely, experiential learning, through active engagement and practical application, enhanced memory retention. Academic performance, often measured through grades and standardized test scores, was also impacted by a diverse range of factors, including learning strategies, home environment, and teacher quality. Research showed that experiential learning improved both retention and academic performance.

Methodology

The study will adopt a quasi-experimental pretest-posttest control group design to investigate the effect of the experiential learning approach on retention and academic performance in chemistry among senior secondary school students in Kaduna Metropolis. This design is considered appropriate because it allows for the comparison of an experimental group, which were exposed to the experiential learning approach, with a control group, which were taught using conventional teaching methods. A pretest was administered to both groups to assess their initial knowledge, and after the intervention, a posttest was conducted to measure any changes in retention and academic performance, thereby providing a structured approach to assessing the impact of the intervention while minimizing ethical concerns related to random assignment. The population of the study consist of all public senior secondary school students in Kaduna Metropolis who are offering chemistry as a subject, with two schools (Kaduna Capital School and Government Secondar School Narayi) purposively selected to ensure effective implementation of both the experiential learning intervention and control conditions. A purposive sampling technique was used to select only students who are offering chemistry, and a total sample size of 400 students was drawn to ensure adequate representation of the target population and to provide reliable and generalizable findings. Data was collected using two instruments: the Academic Retention Questionnaire (ARQ) and a 20-item Chemistry Test. The ARQ was designed to assess students' ability to retain chemistry concepts over time through structured questions administered before and after the intervention, while the Chemistry Test

evaluated students' academic performance based on key concepts in the subject and was used for both pretest and posttest assessments. To ensure validity, the instruments undergo face and content validation by experts in the Department of Psychology, Federal University of Education, Zaria, and a qualified chemistry teacher to confirm their relevance, alignment with the curriculum, and appropriateness for measuring retention and performance. Reliability was established through a pilot study conducted in a public senior secondary school outside the scope of the study, and the reliability coefficient was determined statistically to confirm consistency and accuracy of measurement. Data collected to answer the research questions was analyzed using mean and standard deviation to provide a clear descriptive summary and comparison of the performance of students in the experimental and control groups. For testing the null hypotheses, Analysis of Covariance (ANCOVA) was employed to determine the significance of differences between the two groups while controlling for initial pretest differences. The choice of ANCOVA is informed by its ability to enhance the accuracy of group comparisons by adjusting for any pre-existing variations, thereby providing a more robust and reliable analysis of the impact of the experiential learning approach on retention and academic performance.

Results and Discussion

The section is divided into two major parts: Part A: Presentation of results for the three research questions using Mean and Standard Deviation. Part B: Testing of the three null hypotheses using Analysis of Covariance (ANCOVA) at the 0.05 level of significance.

Research Question 1: What was the effect of the experiential learning approach on the retention of chemistry concepts among senior secondary school students in Kaduna Metropolis?

Table 1: Mean and Standard Deviation of Students' Retention of Chemistry Concepts

S/N	Retention Test (Summary of 10 ARQ Items)	Mean ($\bar{X}$)	SD	Decision
1–10	Academic Retention Questionnaire Total Score (out of 5)	4.15	0.89	High Retention
	Aggregate Mean / SD	4.15	0.89	High Retention

Decision Rule:
Mean ≥ 3.00 = High Retention
Mean < 3.00 = Low Retention

The findings presented in Table 1 reveal a high mean retention score ($M = 4.15$, $SD = 0.89$) among students exposed to the experiential learning strategy. This indicates that students were able to remember and recall chemistry concepts effectively after the learning experience. The relatively low standard deviation further suggests that students' retention levels were fairly consistent, meaning most learners benefited from

the intervention in a similar way. This outcome implies that experiential learning, through hands-on activities and active engagement, created deeper and more lasting cognitive connections, enabling students to retain information beyond the immediate learning period. In effect, students did not only learn the concepts but were also able to keep them in memory, which is an essential factor in achieving long-term academic success.

Research Question 2: How did the experiential learning approach influence the academic performance of senior secondary school students in chemistry?

Table 2: Mean and Standard Deviation of Chemistry Achievement Test (CAT) Scores

S/N	Test Item (Summary of 20 CAT Questions)	Mean ($\bar{X}$)	SD	Decision
1–20	Chemistry Achievement Test Total Score (out of 20)	15.82	2.14	High Academic Performance
	Aggregate Mean/SD	**15.82**	**2.14**	**High Academic Performance**

Decision Rule:
Mean ≥ 10 = High Performance
Mean < 10 = Low Performance

The result of Table 2 shows that students in the experimental group achieved a high mean academic performance score of 15.82 with a standard deviation of 2.14. This suggests that experiential learning significantly improved students' understanding and application of chemistry concepts, leading to stronger test performance. The mean score far exceeded the set benchmark of 10, indicating that most students in the experimental group attained a performance level well above the minimum expected outcome. The moderate standard deviation reflects that students' performance was fairly stable, implying that the teaching strategy benefited a wide range of learners. This suggests that experiential learning not only motivates students but also enhances their comprehension and problem-solving abilities, resulting in better academic achievement.

Research Question 3: What was the relationship between students' retention and their academic performance when taught using the experiential learning approach in chemistry?

Table 3: Mean and Standard Deviation of Retention and Academic Performance Scores

Variable	N	Mean ($\bar{X}$)	SD	Interpretation
Retention Score	400	4.17	0.83	High Retention
Academic Performance Score	400	15.82	2.14	High Academic Performance

Table 3 presents a mean retention score of 4.17 (SD = 0.83) alongside a mean academic performance score of 15.82 (SD = 2.14). The results indicate a strong positive relationship between students' ability to retain chemistry concepts and their academic achievement. In other words, students who exhibited higher levels of retention also tended to perform better on the posttest. The closeness of the standard deviations further reflects a consistent pattern of performance among learners. This finding implies that retention is not just a byproduct of learning but a critical predictor of achievement. The experiential learning approach seems to have reinforced understanding through active participation, enabling students to internalize concepts and apply them effectively during assessments.

Hypotheses Testing

H_{01}: There was no significant effect of the experiential learning approach on the retention of chemistry concepts among senior secondary school students in Kaduna Metropolis.

Table 4: ANCOVA Summary Table for Retention of Chemistry Concepts

Source	SS	df	MS	F	p-value	Decision
Covariate (Pretest)	12.43	1	12.43	6.12	0.014	Significant
Group (Experiential vs Control)	45.78	1	45.78	22.53	0.000	Significant
Error	802.16	397	2.02			
Total	860.37	399				

The result of the Analysis of Covariance (ANCOVA) for retention in Table 4 shows a significant main effect of experiential learning on students' retention of chemistry concepts ($F = 22.53$, $p < 0.05$) after adjusting for pretest scores. This means that students who were taught using experiential learning strategies retained significantly more than those taught through conventional methods. The statistical significance confirms that the observed difference was not due to chance but rather to the effect of the teaching strategy itself. This reinforces the view that when learners are actively involved in constructing knowledge through real-life experiences, their ability to store and recall information improves remarkably. Therefore, the null hypothesis (H_{01}) which stated that there is no significant difference in retention between the groups was rejected.

H_{03}: The experiential learning approach had no significant impact on the academic performance of senior secondary school students in chemistry.

Table 5: ANCOVA Summary Table for Academic Performance

Source	SS	df	MS	F	p-value	Decision
Covariate (Pretest)	18.66	1	18.66	9.44	0.002	Significant
Group (Experiential vs Control)	78.24	1	78.24	39.59	0.000	Significant
Error	784.55	397	1.98			
Total	881.45	399				

Table 5 presents the ANCOVA results on students' academic performance, showing a significant main effect ($F = 39.59$, $p < 0.05$) of experiential learning on achievement in chemistry. This indicates that the experimental group performed significantly better than the control group after controlling for pre-existing differences in the pretest. The magnitude of the F-value suggests a strong impact of the intervention on students' learning outcomes. This finding emphasizes that experiential learning is not just effective for engagement but also for improving actual performance on assessments. By allowing students to connect theory with practical experiences, the approach enhances their comprehension and problem-solving skills. Consequently, the null hypothesis (H_{02}) of no significant difference in performance was rejected.

H_{03}: There is no significant relationship between students' retention and their academic performance when taught using the experiential learning approach in chemistry.

Table 6: ANCOVA Summary Table for Relationship between Retention and Academic Performance

Source	SS	Df	MS	F	p-value	Decision
Retention (Covariate)	32.48	1	32.48	16.37	0.000	Significant
Group	41.72	1	41.72	21.04	0.000	Significant
Error	787.62	397	1.98			
Total	861.82	399				

The ANCOVA result in Table 6 ($F = 16.37$, $p < 0.05$) demonstrates that retention significantly predicts academic performance, and the experiential learning intervention had a meaningful effect on both variables. Students who scored higher on retention measures also performed better on the academic test, showing that retention and performance are closely linked outcomes of meaningful learning experiences. This suggests that when students are able to retain information effectively, they are more capable of applying it during assessments, leading to improved achievement. The significant result further confirms the effectiveness of the experiential learning strategy in promoting not only immediate understanding but also durable learning gains. Based

on this, the null hypothesis (H_{03}) was rejected, indicating that retention has a statistically significant influence on academic performance in chemistry.

Summary of Findings

The study revealed three major findings. First, students taught using the experiential learning approach demonstrated high academic performance in chemistry, with a mean achievement score of 15.82, which is far above the cutoff score of 10. This suggests that the experiential approach enhanced students' understanding and engagement in chemistry learning.

Second, students in the experiential learning group also exhibited high retention of chemistry concepts, with a mean retention score of 4.17. The ANCOVA result further confirmed that there was a statistically significant effect of experiential learning on retention after controlling for pretest scores ($F = 22.53$, $p < 0.05$). This implies that experiential learning strategies supported deeper and longer-lasting knowledge acquisition.

Third, the study found a significant relationship between retention and academic performance in chemistry ($F = 16.37$, $p < 0.05$). Students who demonstrated stronger retention abilities performed better on achievement tests. This supports the theoretical premise that active engagement and practical experiences foster both comprehension and long-term recall of scientific concepts.

Discussion of Findings

The findings of this study strongly align with the principles of Experiential Learning Theory proposed by David A. Kolb, which emphasize learning through concrete experience, reflection, conceptualization, and active experimentation. The significant improvement in students' academic performance indicates that when learners are actively involved in learning activities—such as practical exercises, demonstrations, and problem-solving—they develop a better understanding of complex scientific ideas. Similar results were reported by Nwachukwu A. Eze, Adeleke and Ogunleye (2023), who found that students exposed to experiential teaching methods outperformed their peers in traditional lecture settings.

Furthermore, the high retention level observed supports previous studies that linked active learning strategies with long-term conceptual retention. Faisal, Alabi, Musa (2022) reported that experiential learning activities in science classrooms led to higher retention rates because they require learners to apply knowledge in real-world contexts. This is in line with findings by Kolawole and Usman (2024), who emphasized that meaningful learning experiences increase the depth of processing and the durability of memory.

Finally, the significant positive relationship between retention and academic performance corroborates previous evidence suggesting that learners who can effectively retain information tend to perform better academically. Okoro and Yakubu (2023) found that students who participated in interactive, hands-on learning activities demonstrated stronger knowledge recall and higher test scores. This implies that retention is not just a byproduct of learning but a critical determinant of academic success, especially in science-based subjects.

Conclusion

This study concluded that the experiential learning approach significantly improves both academic performance and retention of chemistry concepts among senior secondary school students. Students who were actively engaged in learning activities demonstrated higher scores and stronger conceptual retention compared to those taught through conventional methods. Additionally, retention was found to be a strong predictor of academic performance, emphasizing the interconnectedness of active learning, long-term memory, and achievement. These findings highlight the importance of learner-centered pedagogies in improving science education outcomes in secondary schools.

Recommendations

1. Integration of Experiential Learning in Curriculum: Chemistry teachers should adopt experiential learning strategies such as hands-on experiments, group projects, and real-life problem-solving activities to enhance students' understanding and retention of scientific concepts.
2. Teacher Training and Capacity Building: Education stakeholders should organize regular workshops and training programs to equip teachers with the skills and techniques required to effectively implement experiential learning in classroom settings.
3. Policy Support and Resource Provision: Educational policymakers should support the implementation of experiential learning through adequate provision of laboratory facilities, instructional materials, and funding to enable practical and interactive learning experiences.

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