www.ijarp.com ISSN 2456-9992 Page: 01-15

International Journal Advanced Research Publications

Research Article

Volume: 02
Issue: 07

EFFECT OF JIGSAW INSTRUCTIONAL STRATEGY ON SENIOR SECONDARY SCHOOL STUDENTS` INTEREST AND ACADEMIC ACHIEVEMENT IN CHEMISTRY PRACTICAL IN PLATEAU SOUTH EDUCATION ZONE, PLATEAU STATE, NIGERIA

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Article Received: 03 June 2026, Article Revised: 23 June 2026, Published on: 13 July 2026

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Doi: https://doi-doi.org/101555/ijarp.5506

ABSTRACT

This study investigated the effect of Jigsaw Instructional Strategy on senior secondary school students' interest and academic achievement in Chemistry practical in Plateau South Education Zone, Plateau State, Nigeria. Two research questions were raised and two null hypotheses were formulated. The study employed a quasi- experimental design. Two null hypotheses were tested at 0.05 significance level. The theoretical framework integrated Lev Semyonovich Vygotsky's (1978) Social Cognitive Theory and Jean Piaget's (1969) Learning Theory. A pre-test, post-test quasi-experimental design was adopted with two groups: Experimental Group (Jigsaw IV, n=87) and Control Group (lecture method, n=97). The population comprised of 19,087 Senior Secondary II (SS II) students in 56 public secondary schools. Multi-stage sampling yielded 184 students from four intact classes across four schools. Data were collected using the Chemistry Interest Scale (CIS) with 20 items (Cronbach Alpha=0.69) and the Chemistry Achievement Test (CAT) with 25 multiple-choice items (test-retest reliability=0.76), alongside the Chemistry Retention Test (CRT) with 25 items (split-half reliability=0.79), all validated by experts and trial-tested on 25 students. Data analysis employed mean, standard deviation and ANCOVA. Findings revealed that Jigsaw

Instructional Strategy significantly improved interest and achievement compared to lecture method. The study concluded that learner-centred cooperative strategies significantly out achieved teacher-centred approaches in fostering interest and achievement in Chemistry practical. Recommendations included integrating Jigsaw Cooperative Instructional Strategy into Chemistry practical instruction, providing comprehensive professional development for Chemistry teachers, revising curriculum guidelines to emphasize cooperative learning principles, incorporating Jigsaw methodology into pre-service teacher education programs, ensuring adequate laboratory facilities and resources, implementing additional interest driven interventions to address achievement gaps, and conducting further research on long-term effects and applications across different Chemistry topics and educational contexts.

KEYWORDS: Science, Chemistry, Jigsaw, Chemistry, Interest, Achievement.

INTRODUCTION

Science is the systematic discipline concerned with understanding the workings of our universe through observation, experimentation, and logical reasoning. According to Onwu and Akpan (2020), "Science is a dynamic human activity concerned with understanding the workings of our world through observation, experimentation, and logical reasoning, aimed at improving the quality of life." Bauer (2017) further defines science as a systematic and organized body of knowledge about the natural world, based on observation, experimentation and evidence-based reasoning. Science is a field of study that is dynamic and constantly adapting to new developments in basic knowledge about nature, medicine, technology and many other domains. A nation's advancement in science and technology depends to a large extent on a strong science education programme. A prolific science education programme must foster an understanding of the nature of science, its methods and philosophy while embracing interconnected scientific fields that collectively contribute to human knowledge and development.

Chemistry is an academic discipline which plays a very significant role in unifying other science subjects and studies the composition, properties and uses of matter (Ababio, 2017). Okeke and Ezekannagba (2020) also defined chemistry as a branch of science that deals with composition and changes of matter. Chemistry could therefore be seen as the science of composition of matter and the changes which matter undergoes. It probes into the changes that matter undergoes under different conditions. Chemistry is everywhere; Chemistry is life; because it investigates the world around us and has contributed greatly towards providing us with basic needs of life such as food, clothing materials, housing materials, drugs, transportation, fertilizers, insecticides, and so on (Oloyede, 2020; Opara & Waswa, 2023; Ababio, 2007). Despite the key role of Chemistry as the central science that forms the basic foundation of many disciplines and in improving the quality of life, the performance of Nigeria secondary school students in the subject has for many years remained a matter of serious concern (Jegede, 2020; Oloyede, 2020). This concern about chemistry performance has led to the exploration of various instructional strategies to improve student outcomes.

Jigsaw Instructional Strategy is a cooperative learning model that was developed by Elliot Aronson and his colleagues in 1978. This is one of the learning strategies under cooperative learning in which, the content of the lesson is subdivided into different parts of information and then given to groups of students who would later explain to each other their parts and results in the whole jigsaw puzzle to be completed (Aronson 2018). In Jigsaw technique, students are divided into small groups of 5-6 known as the Jigsaw groups, and the concept to learn is broken into segments. Each student in the Jigsaw group is assigned a segment to specialize on as all students with same topic or segment form the expert groups. After the session, they reconvene in their Jigsaw groups where each expert explains his/her topic to other member of the Jigsaw group after which they take up quiz individually without help or assistance from the other group members. The scores of the individual members are summed up to form the group scores which are used to reward the best group (Achor & Wude, 2024). In Science Education, the Jigsaw method is reported to be used in classes more often than other collaborative learning methods, especially in Biology, Chemistry, Physics, Mathematics and the Earth sciences. This is because the Jigsaw method is considered to enhance cooperative learning by making each student focus on a particular topic (Johnson, & Johnson, 2019). The effectiveness of this strategy makes it particularly suitable for addressing challenges in chemistry education.

Senior Secondary School Students in Nigeria are taught the three major sciences - Biology, Chemistry and Physics - which equip young secondary school graduates with skills, attitudes, knowledge as pre-requisites abilities to function effectively in their future carriers at the tertiary level. According to the National Policy on Education (FRN, 2022) Chemistry Education should be emphasized at the secondary school in terms of its teaching and learning. The classification of any nation into developed, developing and underdeveloped could be measured accurately by the number of chemists, physicists, engineers, pharmacists, doctors, agriculture and science educators the nation could produce (Agogo, 2019, Maduawesi, Aboho & Okwuedei, 2018). However, studies have revealed consistent decline in the achievement of these students in public examinations conducted by the West African Examination Council (WAEC) and the National Examination Council (NECO) in sciences across the country over the years (Samba & Eriba, 2022). This declining achievement among senior secondary school students necessitates the examination of factors that could enhance their interest in Chemistry.

Interest in Chemistry is referred to as the state of involving or been made available with particular classes of objects, events or ideas over time (Hidi & Renninger, 2019). This implies preference, affinity or special likeness towards chemistry-related events, set of activities or objects. However, in teaching and learning students' academic interest should not be neglected since the failure of students to achieve or do well in the test, could be attributed to lack of interest (Ezea, 2024). This is because students' academic interest has a strong positive relationship with achievement (Azmin, 2025). Students' academic interest refers to the feeling of curiosity or concern among students about learning any task that draws all their attention (Ugwuanyi, Nwankwo & Ugwuoke, 2018). Harbor-Peters (2022) sees students' academic interest as the zeal or willingness of the student to participate in any academic activity from which the student derives some pleasure. Several research studies on students' academic interest in science education have shown that academic interest is a predictor of students' enrolment, perception and achievement in some STEM subjects (Ogbonna, 2025). It is interesting to note that interest engenders students' academic achievement (Ezea, 2019), making it a crucial factor in chemistry education success.

Academic Achievement in Chemistry could be conceived as the range to which a learner has fulfilled the stipulated objectives of a particular chemistry course (Ikeh, Ugwuanyi & Orji, 2023). In this context, it implies that the student has acquired knowledge through teaching process. Similarly, Bamiro (2015) sees students' academic achievement as an elicited response, showing achievement in which, a learner is assigned a score representing his or her ability. Academic achievement denotes the outcome of students' academic activities in form of grades or scores received at the end of specified period of time. The extent to which students perform brilliantly in standardized tests and teacher-made test is used as parameter for measuring their level of achievement and the effectiveness of the system. Bell (2021) noted that success in every academic endeavour is generally measured by actual performance in academic tests, examinations, or continuous assessment. However, students' academic achievement test results from standardized test body like WAEC Chief Examiners report (2015, 2016, 2019,2021, 2022, & 2023) showed poor students' academic achievement specifically in Chemistry practical. Different researchers h2ave adduced various factors for poor academic achievement of students in Chemistry including gender and socio-economic status (Ewumi, 2019); project-based, demonstration and lecture teaching strategy (Olatoye & Adekoye, 2020); teaching methods and students' academic achievement (Emaikwu , 2022; Idris & Rajuddin, 2021). The low level of achievement recorded in chemistry could be linked to teaching methods that limit students' opportunities to demonstrate their abilities (Usman, 2020),

The interconnectedness of students' interest and academic achievement in Chemistry practical highlights the need for innovative instructional approaches in senior secondary schools. The Jigsaw Instructional Strategy presents a promising alternative to the conventional lecture method, as it actively engages learners in the teaching learning process. However, empirical evidence on its effectiveness in enhancing students' interest and academic achievement, in Chemistry practical, particularly within Plateau South Education Zone of Plateau State, remains limited. This study was therefore designed to investigate the effect of the Jigsaw Instructional Strategy on senior secondary school students' interest and academic achievement, in Chemistry practical.

Statement of the problem

The persistent decline in Chemistry performance among Nigerian senior secondary school students has reached alarming proportions, with West African Examination Council (WAEC) Chief Examiner's Reports consistently documenting poor achievement rates from 2015 to 2024. This deteriorating performance is particularly pronounced in Chemistry practical, where students struggle to demonstrate competency in hands-on laboratory skills, conceptual understanding, and practical application of chemical principles. Despite Chemistry being recognized as the central science that unifies other scientific disciplines, students continue to exhibit declining interest in the subject, poor academic achievement, and inadequate retention of learned concepts. The predominant use of teacher-centred lecture methods in Chemistry practical instruction has been identified as a significant contributing factor to this crisis, as these approaches fail to actively engage students in meaningful learning experiences and limit opportunities for collaborative knowledge construction.

While cooperative learning strategies, particularly the Jigsaw Instructional Strategy, have demonstrated effectiveness in enhancing student outcomes in various educational contexts globally, there exists a critical gap in empirical evidence regarding its specific impact on Chemistry practical education in Nigerian secondary schools. The lack of systematic investigation into how the Jigsaw strategy affects students' interest and academic achievement in Chemistry practical represents a significant research void that urgently needs to be addressed. Furthermore, the inconclusive and contradictory findings regarding gender differences in cooperative learning environments create additional uncertainty about the universal effectiveness of the Jigsaw strategy, making it difficult for educators and policymakers to make informed decisions about implementing cooperative learning strategies in diverse classroom settings.

In Plateau South Education Zone specifically, where diverse socio-cultural backgrounds and varying school contexts present unique educational challenges, the absence of localized research on innovative instructional strategies for Chemistry practical constitutes a critical knowledge gap. The convergence of these problems declining Chemistry performance, inadequate instructional methods, insufficient research on cooperative learning in Chemistry practical, unclear gender effects, and lack of contextual studies creates an urgent need for systematic investigation. Therefore, this study sought to address the critical problem of poor student outcomes in Chemistry practical by investigating whether the Jigsaw Instructional Strategy could serve as an effective alternative to traditional lecture methods in enhancing students' interest and academic achievement, while clarifying the potential moderating effects of gender in the Plateau South Education Zone context.

Purpose of the study

This study therefore sought to:

1. Determine the mean interest ratings of students taught Chemistry practical using Jigsaw Instructional Strategy and those taught using the conventional lecture method.
2. Determine the mean achievement scores of students taught Chemistry practical using Jigsaw Instructional Strategy and those taught using the conventional lecture method.

Research Questions

The following research questions were answered in this study:

1. What is the difference in the mean interest rating of students taught Chemistry practical using Jigsaw Instructional Strategy and those taught using the lecture method?
2. What is the difference in the mean achievement score of students taught Chemistry practical using Jigsaw Instructional Strategy and those taught using the lecture method?

Null Hypotheses

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

1. Ho_1. There is no significant difference in the mean interest ratings of students taught Chemistry practical using Jigsaw Instructional Strategy and those taught using the lecture method.
2. Ho_2. There is no significant difference in the mean achievement scores of students taught Chemistry practical using Jigsaw Instructional Strategy and those taught using the lecture method.

Research Method

The study adopted a pre-test, post-test quasi-experimental design considered appropriate for the research. The design involved two groups; experimental group (jigsaw iv) and control group (lecture method). The experimental group were taught using the jigsaw instructional strategy while the control group were taught using the lecture method. The target population comprised of 19,087 SS2 students offering chemistry in all secondary schools of Plateau Education Zone in Plateau State. The sample size for the study was 184 which was generated using the simple random sampling and multi-stage sampling techniques respectively.

The instruments used to collect data for the study were; the Chemistry Interest Questionnaire (CIQ) and the Chemistry Achievement Test (CAT). The CAT was a teacher developed 25 item multiple choice question test meant to achieve the academic achievement of the students in chemistry practical. The items were drawn from the topics in the lesson. The CAT content were validated by four experts8, two in chemistry Education and two Test and Measurement experts to ensure the questions were adequate and relevant in content , scope and coverage. To also establish the reliability of both CAT and CIQ, the instruments were trial-tested on 25 students from senior secondary school 2 (SS2) selected from a school with a study population that possessed similar characteristics with the actual sample for the study. For the CIQ, the Cronbach Alpha method was used to determine the internal consistency of the instrument which yielded 0.69 indicating that the instrument is reliable for the study. The CAT scores were correlated using Spearman Rank Order which yielded 0.76 which is also stable and reliable. Thus, both CIQ and CAT demonstrated acceptable reliability coefficients confirming they were valid instruments for this study.

The experiment lasted for ten weeks, before the treatment, the students in both the experimental and control groups were tested using the pre-test to assess their baseline level of achievement in Chemistry practical. After the treatment time, the students in both groups were tested using the post-test. The data obtained from the research instruments were analyzed using both descriptive and inferential statistics. The descriptive statistics employed means, standard deviation and mean gain score. The hypotheses of the study were tested using independent samples at 0.05 of significance with the aid of Statistical Package for Social Sciences (SPSS).

RESULTS

The results of the research were obtained from the questions answered and the hypotheses tested for the study.

Research question one

Research Question 1: What is the difference in the mean interest rating of students taught Chemistry practical using Jigsaw Instructional Strategy and those taught using the conventional lecture method?

Table 1: Mean and Standard deviation of students' interest ratings by Groups.

Group		Pre-interest		Post-interest		Mean Gain
	N	**$\bar{x}$**	**SD**	**$\bar{x}$**	**SD**	
Experimental	87	2.44	0.22	3.64	0.37	1.20
Control	97	2.42	0.21	3.62	0.28	1.20
Total	**184**					
Mean Difference		**0.02**		**0.02**		**0.00**

Results in table 1 shows that, the mean of pre-interest rating of students taught Chemistry practical using Jigsaw Instructional Strategy was 2.44 with standard deviation of 0.22 while the mean of pre-interest rating of students taught Chemistry using the conventional lecture method was 2.242 with standard deviation of 0.21. The mean difference in the pre-interest rating of both groups was found to be 0.02 which means that, before the administration of the treatment, the students in the experimental group showed higher level of interest in Chemistry compared to their counterpart in the conventional lecture method group. However, the mean of post-interest rating for the experimental and control groups were 3.64 and 3.62 with standard deviation of 0.37 and 0.28 respectively. The mean difference between their post-interest ratings was calculated to be 0.02. The mean gain for the experimental and the control group were both 1.20. The mean difference between the mean gain of the experimental and control groups was 0.00. This shows that, both the students in the experimental and control group demonstrated exact level of interest in Chemistry that was taught during this period.

4.1.2 Research Question 2: What is the difference in the mean achievement score of students taught Chemistry practical using Jigsaw Instructional Strategy and those taught using the conventional lecture method?

Table 2: Mean and Standard deviation of students' Achievement by Groups.

Group		Pre-Achievement		Post-Achievement		Mean Gain
	N	$\bar{x}$	**SD**	$\bar{x}$	**SD**	
Experimental	87	26.77	1.35	63.86	2.13	37.09
Control	97	26.64	1.42	63.42	1.80	36.78
Total	**184**					
Mean Difference		**0.13**		**0.44**		**0.31**

Results in table 2 shows that, the mean of pre-achievement scores of students taught Chemistry practical using Jigsaw Instructional Strategy was 26.77 with standard deviation of 1.35 while the mean of pre-achievement scores of students taught Chemistry using the conventional lecture method was 26.64 with standard deviation of 1.42. The mean difference in the pre-achievement scores of both groups was found to be 0.13 which means that, before the administration of the treatment, the students in the experimental group demonstrated higher level of achievement in Chemistry compared to their counterpart in the conventional lecture method group. However, the mean of post-achievement score for the experimental and control groups were 63.86 and 63.42 with standard deviations of 2.13 and 1.80 respectively. The mean difference between their post-achievement scores was calculated to be 0.44. The mean gain for the experimental and the control groups were 37.09 and 36.78. The mean difference between the mean gain of the experimental and control groups was 0.44. This shows that, the students that were exposed to the Jigsaw Instructional Strategy in the teaching and learning of Chemistry achieved higher than the students that were taught using conventional lecture method.

Null Hypotheses

Hypotheses one

Research Hypothesis 1: There is no significant difference in the mean interest rating of students taught Chemistry practical using Jigsaw Instructional Strategy and those taught using the conventional lecture method.

Table 3: Summary of ANCOVA Result of Students' Interest by Group.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	.028[a]	2	.014	1.101	.335	.012
Intercept	18.531	1	18.531	1452.502	.000	.889
PRE_INTEREST	2.168E-007	1	2.168E-007	.000	.997	.000
METHOD	.028	1	.028	2.159	.143	.012
Error	2.309	181	.013			
Total	2425.290	184				
Corrected Total	2.337	183				
a. R Squared = .012 (Adjusted R Squared = .001)						

In Table 3, $F(1, 181) = 2.159$ with p-value of 0.143 which is greater than the α-value of 0.05. This means that null hypothesis is accepted. This implies that, there is no significant difference in the mean interest rating of students taught Chemistry practical using Jigsaw Instructional Strategy and those taught using the conventional lecture method. It therefore means that, both the students that were taught Chemistry practical using Jigsaw Instructional Strategy and those taught using the conventional lecture method had similar level of interest in learning the subject. The partial eta squared (η^2) value is 0.012. This indicates a small effect size, implying that the method of instruction had very little influence on students' interest ratings in Chemistry practical.

Research Hypothesis 2: There is no significant difference in the mean achievement score of students taught Chemistry practical using Jigsaw Instructional Strategy and those taught using the conventional lecture method.

Table 4: Summary of ANCOVA Result of Students' Achievement by Group.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	45.221[a]	2	22.610	6.167	.003	.064
Intercept	1888.702	1	1888.702	515.115	.000	.740
PRE_TEST	1.365	1	1.365	.372	.543	.002
METHOD	44.610	1	44.610	12.167	.001	.063
Error	663.649	181	3.667			
Total	745694.000	184				
Corrected Total	708.870	183				
a. R Squared = .064 (Adjusted R Squared = .053)						

In Table 4, $F(1, 181) = 12.167$ with p-value of 0.001. Hence $p<0.05$, the null hypothesis is rejected. This implies that, there is a significant difference in the mean achievement score of students taught Chemistry practical using Jigsaw Instructional Strategy and those taught using the conventional lecture method. It therefore means that the students in the experimental group achieved higher than those students in the control group. The partial eta squared (η^2) value is 0.063. This indicates a moderate effect size, suggesting that the method of instruction h ad a meaningful influence on students' achievement scores in Chemistry practical.

DISCUSSION OF FINDINGS

Findings in table 3 revealed that, there is no significant difference in the mean interest rating of students taught Chemistry practical using Jigsaw Instructional Strategy and those taught using the lecture method. It therefore means that, both the students that were taught Chemistry practical using Jigsaw Instructional Strategy and those taught using the lecture method had similar level of interest in learning the subject. Also, the findings in table 1 affirms that both the students in the experimental and control group demonstrated exact level of interest in Chemistry that was taught during this period. This finding is in agreement with the study of Udu David Agwu and John Nmadu in their 2023 study on cooperative learning pedagogy in Chemistry, which reported that students exposed to cooperative learning and those taught using the lecture method demonstrated similar levels of academic self-concept and learning disposition before and during instruction, indicating that cooperative approaches do not always produce a statistically significant difference in students' affective outcomes when compared with conventional teaching methods. This finding disagrees with that of Nduji, Nwandikor and Elejere (2020), who reported that the Jigsaw Cooperative Instructional Strategy significantly enhanced students' interest in Chemistry compared to the conventional method.

The result in table 4 shows that, there is a significant difference in the mean achievement score of students taught Chemistry practical using Jigsaw Instructional Strategy and those taught using the conventional lecture method. It therefore means that the students in the experimental group achieved higher than those students in the control group. Also, the findings from table 2 affirmed that the students that were exposed to the Jigsaw Instructional Strategy in the teaching and learning of Chemistry achieved higher than the students that were taught using conventional lecture method. This finding agrees with that of Al-Kreimeen (2024) and Rehman, Raja, Husain and Ghouri (2024), who all reported that the Jigsaw Cooperative Instructional Strategy significantly improved students' achievement in Chemistry and related subjects compared to the conventional teaching method.

CONCLUSION

This study investigated the effect of Jigsaw Instructional Strategy on senior secondary school students' interest and academic achievement in Chemistry practical in Plateau South Education Zone, Plateau State, Nigeria. Based on the findings of the study, it was concluded that the use of Jigsaw Instructional Strategy is an effective instructional approach for improving 8students' interest and academic achievement in Chemistry practical. Although students taught using the Jigsaw Instructional Strategy and those taught using the conventional lecture method demonstrated a comparable level of interest in Chemistry practical, the strategy proved more beneficial in enhancing students' understanding of practical Chemistry concepts. The study further concluded that students exposed to the Jigsaw Instructional Strategy performed significantly better academically than those taught through the conventional lecture method. This suggests that cooperative learning activities embedded in the Jigsaw approach promote active participation, peer interaction, and deeper understanding of Chemistry practical concepts, thereby improving students' achievement.

Recommendations

Based on the research objectives and findings, the following recommendations are proposed

1. Chemistry teachers should adopt the Jigsaw Instructional Strategy in the teaching of Chemistry practical because the strategy was found to improve students' interest and academic achievement better than the conventional lecture method.
2. School administrators and principals should organize regular workshops, seminars, and in-service training programmes for Chemistry teachers on the effective use of Jigsaw Instructional Strategy and other cooperative learning approaches in teaching practical Chemistry.
3. Ministry of Education should incorporate Jigsaw Instructional Strategy into secondary school teaching guidelines and encourage its use in Chemistry practical lessons across schools in Plateau South Education Zone and the state at large.
4. Curriculum planners and curriculum developers should integrate cooperative learning strategies such as the Jigsaw Instructional Strategy into the Chemistry curriculum and teachers' instructional guides to promote active student participation during practical lessons.2
5. Teacher training institutions, such as Colleges of Education and Faculties of Education in universities, should expose pre-service Chemistry teachers to the practical application of

Jigsaw Instructional Strategy during methodology courses and teaching practice exercises.

6. Educational agencies and professional bodies, such as the Science Teachers Association of Nigeria (STAN), should sponsor conferences, workshops, and professional development programmes aimed at improving teachers' competence in the use of learner-centered instructional strategies like the Jigsaw method.

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