EFFECT OF JIGSAW TEACHING STRATEGY ON ACADEMIC ACHIEVEMENT AND INTEREST IN CHEMISTRY AMONG SENIOR SECONDARY SCHOOL STUDENTS IN GOMBE, GOMBE STATE, NIGERIA

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Abstract
This study investigates the Effect of the Jigsaw Teaching Strategy on academic achievement and interest in chemistry among senior secondary school students in Gombe State, Nigeria. A quasi-experimental design was employed, involving 200 students from two intact classes, randomly assigned to experimental and control groups. The Guttmann Interest Rating Scale (GIRS) was utilized to assess student interest, while academic achievement was measured via a chemistry achievement test. Data were analyzed using Analysis of Covariance (ANCOVA) to test the null hypotheses at a significance level of 0.05. The results revealed a significant improvement in the achievement scores of students who experienced the Jigsaw strategy compared to those taught via conventional methods ($F = 328.562$, $P = .000$). Additionally, gender did not significantly influence achievement ($F = 524.330$, $P = .000$), indicating that the Jigsaw Teaching Strategy effectively enhanced student outcomes across genders. The study recommends integrating the Jigsaw approach into the curriculum as a means of fostering greater engagement and understanding in chemistry education.

Keywords: Jigsaw Teaching Strategy, Conventional teaching method, Achievement, Gender, and Interest in Chemistry.

Introduction

Chemistry is a pivotal subject in the Nigerian educational curriculum, serving as a foundational discipline for various fields, including medicine, pharmacy, and environmental science. Its importance extends beyond mere content knowledge, as it also fosters critical thinking and problem-solving skills among students (National Academies of Sciences, Engineering, and Medicine, 2022). However, significant challenges persist regarding students' performance in chemistry, particularly in Gombe State. Reports from the West African Examinations Council (WAEC) indicate consistent underachievement among senior secondary school students, highlighting ineffective traditional teaching methodologies as a central issue (WAEC, 2015-2022; Muhammad, 2020). This alarming trend underscores the urgent need for innovative teaching strategies aimed at improving academic outcomes while simultaneously fostering greater interest in the subject.

Factors contributing to this decline in performance include outdated teaching techniques and insufficient student engagement (Okoronka, 2018; Omorogbe & Ewansila, 2019). To mitigate these challenges and stimulate increased interest in chemistry, educators are encouraged to adopt student-centered instructional strategies that promote collaborative teaching (Hussein & Neamah, 2020). One particularly promising approach is the Jigsaw Teaching Strategy, developed by Elliot Aronson. This method organizes students into diverse groups, allowing each member to become an expert on a specific topic before sharing knowledge with their peers. By working in these heterogeneous groups, students can leverage their varied academic backgrounds, facilitating mutual support and promoting peer teaching. This collaborative framework not only encourages active participation among all students, regardless of their proficiency levels or socio-economic statuses but also enhances communication skills critical for academic success.

The Jigsaw strategy fosters a deeper understanding of complex chemical concepts, as students must synthesize information from various sources and articulate their findings to classmates. Furthermore, this method nurtures a sense of accountability, as each student's success relies on the contributions of their peers, promoting teamwork and collaboration. Despite the known advantages of the Jigsaw method, there exists a gap in empirical studies examining its effectiveness within the context of Nigerian chemistry education. Given the challenges of mastering complex computations and redox reactions, the Jigsaw strategy offers a practical avenue for enhancing student teaching experiences. By creating a more collaborative environment, this method has the potential to improve both academic achievement and interest in chemistry.

Moreover, student interest is a crucial variable influencing educational outcomes. When students are engaged and find value in the subject matter, they are more likely to invest time and effort into their studies (Samuel & Sambo 2019). Research indicates that a condusive teaching environment, effective teaching resources, and motivational practices significantly affect students' interest Suleiman (2021). Thus, implementing strategies that demystify complex concepts and alleviate student apprehension about chemistry is essential.

This study aims to investigate the impact of the Jigsaw Teaching Strategy on students' academic achievement and interest in chemistry, particularly focusing on redox reactions. Additionally, it seeks to evaluate how this approach addresses longstanding

issues of gender disparity in science education (Peter, Gabriel & Johnson 2020). Gender imbalances in educational outcomes are influenced by various factors, including societal stereotypes and early marriage, which can affect girls' engagement in science (Ojekwu & Ogunleye 2020). By examining the effectiveness of the Jigsaw Teaching Strategy, this research aims to offer valuable insights into its potential for not only enhancing student teaching outcomes in chemistry but also promoting gender inclusivity within the educational process. Ultimately, the findings may contribute to reformed pedagogical practices that can better address the challenges faced by students in Gombe State.

Statement of the Problem

Senior secondary school students in Gombe Metropolis, Nigeria consistently under-performed according to WAEC statistics from 2015- 2022 in chemistry examinations. This persistent underachievement poses a significant challenge to Gombe and by extension, the nations, aspirations in science and technology. Researchers such as Hussein & Neamah, (2020) suggest traditional teaching methods may be a contributing factor. This study aims to investigate the effectiveness of Jigsaw, a cooperative teaching strategy, in addressing this challenge. This study aims to investigate the effectiveness of Jigsaw, a cooperative teaching strategy, in addressing this challenge. The study explored whether Jigsaw improves students' academic achievement, and interest in chemistry. Specificallywith respect to the concept REDOXreactions.

Objective of the Study

The study was aimed to achieve the following objectives:

1 To investigate the effect of Jigsaw teaching strategy on senior secondary school students' academic achievement in chemistry.
2 To determine the effect of jigsaw teaching strategy on senior secondary school-students' interest in Chemistry.

Research Questions

1 What is the effect of Jigsaw teaching strategy on senior secondary school students' academic achievement in chemistry?
2 What is the effect of Jigsaw teaching strategy on senior secondary school students' interest in chemistry?

Research Hypotheses

The null hypotheses were tested at a 0.05 level of significance

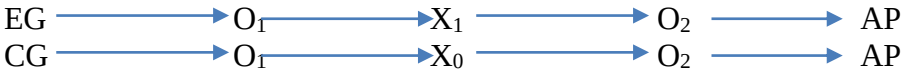
Ho_1: There is no significant effect of Jigsaw teaching strategy on senior secondary school students' achievement in chemistry.

Ho_2: There is no significant effect of Jigsaw teaching strategy on senior secondary school students' interest in chemistry

Methodology

This study adopted a non-equivalent, quasi-experimental research design, specifically a non-randomized pre-test/post-test design with experimental and control groups. This design was selected because random assignment of students to groups was not feasible within the normal school schedule. As such, groups were formed based on existing class structures, ensuring that all students in selected classes could participate. Two instruments were used for data collection in this study, namely Chemistry Achievement Test (CAT) and chemistry Interest Rating Scale (CIRS). The instruments were adapted from past WAEC & NECO 2015-2021) questions, while the chemistry Interest Rating Scale

was adapted from Guttmann Chemistry (2020).



In this representation, O_1 refers to the pre-test, O_2 refers to the post-test, X_1 indicates the implementation of the Jigsaw strategy, and X_0 refers to the traditional method.

The study involved senior secondary school students from selected schools in Gombe Metropolis, Nigeria. A pre-test was administered to both the experimental group (EG) and the control group (CG) to evaluate their knowledge of chemistry concepts and ensure homogeneity at the entry level. The pre-test consisted of items related to the REDOX concept, with the goal of assessing baseline understanding.

The participants were divided into two groups: the experimental group, which received instruction using the Jigsaw teaching strategy, and the control group, which was instructed using traditional lecture-based methods. This division allows for the comparison of academic achievement and interest in chemistry between the two instructional approaches.

The pre-test consisted of multiple-choice and open-ended questions focused on foundational principles and specific aspects of REDOX reactions. The results were used to confirm that the experimental and control groups were homogeneous in terms of prior knowledge. Post-test data were collected using the same instrument that was utilized for the pre-test, ensuring consistency in measurement. To analyze the data and determine the effectiveness of the Jigsaw strategy on students' academic achievement and interest in chemistry compared to traditional teaching methods, the study employed Analysis of Covariance (ANCOVA).

The research design is symbolically represented as follows:

The choice of ANCOVA is justified by the need to control for potential confounding variables, specifically students' initial knowledge and skills in chemistry as measured by the pre-test scores. This is particularly relevant in a quasi-experimental design where random assignment is not possible, as it helps to account for any initial differences between students that could skew the results. By adjusting for pre-test scores, ANCOVA enables a more accurate assessment of the treatment effects of the Jigsaw strategy, thus enhancing the validity of the findings.

Results

The results with respect to the two hypotheses are presented thus:

Table 1: Summary of Analysis of Covariance (ANCOVA) of Pre-Test & Post-Test. Effects of Treatment on achievement in chemistry

Source	Type III Sum of Squares	Df	Mean Square	F	P
Corrected Model	33099.984	3	11033.328	184.88	.000
Intercept	8943.013	1	8943.013	149.888	.000
Instructional Strategy	19603.472	1	19603.472	328.562	.000
Pretest	7063.541	1	7063.541	118.388	.000
Error	11753.900	197	59.664		
Total	607823.000	200			
Corrected Total	44856.395	199			

Research hypothesis 1: There is no significant main effect of jigsaw instructional strategy on chemistry achievement.

The result from Table 1 revealed a significant effect of jigsaw teaching strategy on chemistry achievement (F=328.562; P=.000). That is, a univariate F-ratio of 328.562, P= .000 which was found to be significant beyond the predicted 0.05 level of significance. Therefore, the null hypothesis which states that there is no significant main effect of instructional strategy on chemistry achievement was rejected**.** To determine where a significant effect between-group differences is observed, a post hoc analysis was carried out using pairwise comparisons of means with the least significant difference (LSD) as shown in Table 2.

Table 2: A pairwise comparison of the effect of jigsaw instructional strategy on students' achievement in chemistry
Dependent Variable: Posttest

Group		Mean Difference	Std. Error	Sig. [b]	95% Confidence Interval for Difference	
					Lower Bound	Upper Bound
Experimental	Control	20.380*	1.124	.000	18.163	22.597
Control	Experimental	-20.380*	1.124	.000	-22.597	-18.163

Based on estimated marginal means
*. The mean difference is significant at the .05 level.

The result from Table 2 revealed that there was a statistically significant difference in the students' mean chemistry achievement scores of students following exposure to treatment, P = .000. Hence, the rejection of the null hypothesis 1 was further confirmed. Therefore, it can be concluded that there was a significant effect of instructional strategy on students' chemistry achievement. This implies instructional strategy can enhance students' achievement in chemistry.

Table 3: Summary of Analyses of Covariance (ANCOVA) of Pre-Test & PostTest. Effects of Treatment on interest in chemistry

Source	Type III Sum of Squares	Df	Mean Square	F	P
Corrected Model	59.588	3	19.863	168.34	.000
Intercept	17.813	1	17.813	150.803	.000
Instructional Strategy	61.935	1	61.935	524.330	.000
Pretest	0.103	1	0.103	0.871	.352
Error	25.754	198	0.130		
Total	2572.095	200			
Corrected Total	85.342	199			

Research hypothesis 2: There is no significant main effect of instructional strategy on Students interest in chemistry

The result in Table 3 revealed a significant effect of instructional strategy on chemistry interest (F=524.330; P=.000). That is, a univariate F-ratio of 524.330, P= .000 which was found to be significant beyond the predicted 0.05 level of significance. Therefore, the null hypothesis four which states that there is no significant main effect of instructional strategy on chemistry interest was rejected. To determine where a significant effect between-group differences is observed, a post hoc analysis was carried out using pairwise comparisons of means with the least significant difference (LSD) as shown in Table 4.

Table 4: A pairwise comparison of the effect of jigsaw instructional strategy on students' interest in chemistry
Dependent Variable: Post-Interest

(I) Treatment	(J) Treatment	Mean Difference	Std. Error	Sig. [b]	95% Confidence Interval for Difference	
					Lower Bound	Upper Bound
Experimental	Control	1.120*	.049	.000	1.023	1.216
Control	Experimental	-1.120*	.049	.000	-1.216	-1.023

Based on estimated marginal means
*. The mean difference is significant at the .05 level.

Discussion and Findings
The findings of this study provide valuable insights into the effectiveness of different instructional strategies on student achievement and interest in chemistry.

The results supported the hypothesis that there would be a significant main effect of instructional strategy on chemistry achievement. The analysis revealed a significant difference between the experimental group (using the jigsaw method and the control group, indicating that the experimental strategy led to significantly higher student achievement in chemistry compared to the traditional method. This finding aligns with previous research by Hussein & Neamah (2020), Ojekwu & Ogunleye (2020), and Nwankwo & Okigbo (2021), which demonstrated the effectiveness of similar instructional strategies in enhancing student teaching outcomes.

The findings also supported the hypothesis that the instructional strategy would have a significant impact on student interest in chemistry. The results showed a significant difference in interest levels between the experimental and control groups, with students in the experimental group demonstrating significantly higher interest in chemistry. This finding is consistent with the work of Samuel (2018), Samuel & Sambo (2019), and Ojekwu & Ogunleye (2020), who found that active teaching strategies, such as the jigsaw method, can enhance student interest.

Conclusion
Based on the findings from this study, it is concluded that: the use of the jigsaw teaching strategy can enhance students' achievement and interest in chemistry better than the use of conventional teaching methods irrespective of students' gender. The results revealed that Jigsaw instruction had the higher mean score than the

conventional lecture teaching method. The reason is that Jigsaw Instruction enables students to remember factual information, answer questions and demonstrate comprehension. It also provides a visual or verbal prompt for students who may have difficulty retaining information when students' study together. As regards to lecture teaching method, it has been established that it can be used to incorporate meaning into newly acquired material. Also, it influences how learners interpret new information and decide what aspects of that information are relevant and irrelevant. Based on the findings of the study, it has been recommended that teachers should facilitate the use of Jigsaw instructional strategy in schools to enhance positive interest of students towards chemistry and that improves their achievement in the subject.

Recommendations

Based on the findings of the study, the following recommendations are put forward.

1. The use of the Jigsaw teaching strategy enhanced the students' achievement and interest in the present study. Therefore, chemistry teachers should be encouraged to use the Jigsaw teaching strategy as a medium of instruction that they can apply to improve their teaching, students' achievement and interest in chemistry.
2. Jigsaw teaching strategy should form part of the Senior Secondary Curriculum, National Teachers Institute, National Commission for Colleges of Education and National Universities Commission curriculum for effective teacher preparation on teaching strategies.
3. Professional bodies like the Science Teachers Association of Nigeria (STAN) should organize seminars and workshops on the Jigsaw teaching strategy to stimulate and popularize their use in classrooms. In particular, such seminars/workshops should focus on the application of the Jigsaw teaching strategy in science teaching especially chemistry looking at the role's chemistry plays in scientific literacy.

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