

**EFFECTS OF JIGSAW IV AND REVERSED JIGSAW INSTRUCTIONAL STRATEGIES ON SENIOR SECONDARY SCHOOL STUDENTS' ACADEMIC PERFORMANCE IN ORGANIC CHEMISTRY IN ZARIA, KADUNA STATE, NIGERIA.**

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**Abstract**

*This study examined the effect of JigsawIV and Reversed Jigsaw Instructional Strategies on senior secondary school science students' academic performance. Quasi experimental research design was employed for the study. The sample for study comprised one hundred and eighteen (118) SS II Science students from three intact classes randomly selected from three public coeducation schools in Zaria Education zone, Kaduna State, Nigeria. Organic Chemistry Performance Test (OCPT) instrument, with the reliability coefficient of 0.81 was use to collate data. Analysis of Covariance (ANCOVA) and t-test were used to test the null hypotheses at 0.05 alpha level of significance. Findings from the study have revealed a significant difference between the academic performance of Chemistry students in JigsawIV, Reversed Jigsaw instructional strategies and conventional Teaching method in favour of the two innovative strategies. This result indicates that the instructional strategies are more effective in enhancing Chemistry students' academic performance than the conventional teaching method. However, students' gender had no influence on their academic*

*performance after exposure to Reversed Jigsaw Cooperative Learning Strategy. Based on the findings of this study, it was recommended that, Science teachers should incorporate JigsawIV and Reversed Jigsaw instructional strategies into the teaching of Chemistry in Senior Secondary Schools in Zaria, Kaduna State.*

**Keywords:** Academic Performance, JigsawIV and Reversed Jigsaw.

### **Introduction**

Science education has become one of the best avenues to meet the global challenges facing the Nigerian nation. Despite the importance of Science and Technology in the country's quest for technological advancement, there has been seeming ineffectiveness in the teaching and learning of the science (Chemistry) subject which in turn is strongly affecting the attainment of the country's laudable objectives and goals of developing a scientific and technologically literate citizenry. Researchers such as Gumel (2015), Samuel (2018), Isa (2018) and Samuel and Sambo, (2019) observed that poor instructional strategies employed in the teaching of science subjects by teachers contribute to students under performance. Students find it difficult to understand the basic concepts taught. In order to achieve the objectives of Chemistry education, the student-activity-based mode of teaching strategies have been recommended by the Federal Republic of Nigeria (FRN, 2014) is Jigsaw Cooperative Learning Strategy.

Jigsaw 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 2008). In Jig-saw 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 Jig-saw groups where each expert explains his/her topic to other member of the Jig-saw 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 (Sahin, 2010).

**The Jigsaw IV**

Jigsaw IV, as developed by Holliday (2002), includes three important new features: an introduction, quizzes, and re-teaching after individual assessment (Holliday, 2002). In order to stimulate student interest in the lesson, the teacher first introduces the lesson by means of lectures, presentation of literature, questioning, proposing problems, or perhaps showing a movie in a 'plenary' class session. Students are then assigned to a heterogeneous group – the home group – and all students are assigned topics to read. Here each student discusses the expert sheet that is based on a list of all topics. Again, the students with the same expert sheet move to their expert group to discuss their topic. In order to check accuracy and understanding of students in the expert group, they are assessed by means of a quiz – this being based on the expert sheet. They return to their home group, teach all their group members and take quizzes all based on the original material. The teacher reviews and clarifies any concepts which it appears the students did not understand. The students take individual quizzes, and scores are combined to produce an overall team score. Finally, the teacher re-teaches any material which was misunderstood after the individual assessment process (Isa & Muhammad, 2019).

**The Reverse Jigsaw**

This is one of the newest methods created by Hedeem (2003) under the cooperative learning techniques used in classroom settings. It follows the same principle as the original Jigsaw method. The jigsaw technique in the cooperative learning methods uses a small group structure to facilitate group discussion through which the learning takes place. The reverse jigsaw method also resembles the original jigsaw method in some way but has its own objectives to be fulfilled. While the jigsaw method focuses on the student's comprehension of the Instructor's material, the reverse jigsaw method focuses on the participant's interpretations such as perceptions, judgments through a very active discussion. This method was mainly created to cater the higher class students. It is best advised to give an explanation before the discussion the topics takes place. This not only ensures that the learners are more effective in their discussion but also saves time. It differs from the original Jigsaw during the teaching portion of the activity. In the Reverse Jigsaw technique, students in the expert groups teach the whole class rather than return to their home groups to teach the content (Heeden, 2003).

The process involved in the reverse Jigsaw method can be explained in 3 steps according to Heeden, (2003).

1. Students gather in mixed groups where they are each given a case study with a number of questions or one complex question and allotted time of about 15 minsto discuss. Each member of the team is given a unique topic and hence a

discussion is initiated within the mixed group and the main points and the outcomes are noted.

2. Each member gather in the expert group or topic group and the points and outcomes are compared. A report is prepared compiling all the common and divergent themes. The time allotted for this could be between 15 - 20 mins. A reporter is appointed to present the same before the class.
3. The class gathers as a whole and the reporters from the individual topic group present their report to the whole class by ways of Overheads, flipcharts or chalk board, following which the instructor debriefs the whole exercise with review or evaluation of the process.

Several studies show that Jigsaw Cooperative Learning Strategy is a learning strategy that enhances students understanding and academic performance in Chemistry (Doymus, (2008); Jansoon, Somsook, and Coll, (2008); Gumel, (2015), in Physics Keramati, (2010); Gambari, Olumori, and Yusuf (2012), in Mathematics (Timayi, Bolaji, & Kajuru, (2015) reported that Jigsaw IV is considerably more effective than individualistic instructional strategy and conventional classroom instruction respectively. However, Seaabon, Ross, and Wilson (2006) found no significant difference in the achievement of students taught using Jigsaw cooperative learning strategy and those taught using conventional classroom and discussion methods respectively.

### **Statement of Problem**

There is growing concern about which strategy or method of teaching in our secondary school should be able to reverse deteriorating trends in students' performance in their study of Chemistry (particularly Organic Chemistry). Some suggestions have been made regarding the identification of Science Teaching Methods and Strategies that motivate students better to learn and achieve superior results in the study of Organic Chemistry. Researchers have indicated that teachers' use of ineffective teaching methods in secondary schools Chemistry is among other factors that have contributed to deteriorating students' performance in Organic Chemistry. The situation, therefore, calls for the use of other innovative teaching strategies that have been found effective in some other subject areas and countries. One of which is the Jigsaw Cooperative Learning Strateg (JCLS). JigsawIV and Reversed jigsaw may produce the desired effective teaching of senior secondary Chemistry concepts particularly Organic Chemistry such that students' performance improves.

Globally, there have been debates on students' performances in Science and Mathematics with respect to gender, which has continued to be of interest and inconclusive (Stoet, & Geary, 2013). Gender has been identified as one of the

factors influencing students' performance in sciences at the senior secondary school level. Olson in Muhammad and Isa (2018) reported that female students performed better than males students when taught Mathematics and sciences using cooperative learning. Lakpini (2006) revealed that male students received more criticism from their teachers than their female counterparts as such that affects their performance in sciences (chemistry). Contrarily, Khairulanuar, Nazre, Sairabanu, and Norasikin (2010) found gender differences in favour of male students. Muhammad, (2017) opined teachers spoke more frequently to boys, asked the boys more questions, praised boys for quality work, and girls for neatness. Even though, Gumel (2015) and Timayi et al (2015) reported that gender had no effect on the academic achievement of students in jigsaw cooperative learning settings. These contradictory findings have caused for the inclusion of gender as one of the moderating variables for this study.

The review showed the inconclusiveness of the findings on Jigsaw Cooperative Learning on Academic performance and gender of the learners. Furthermore, previous studies focused on the comparative effects of cooperative learning strategy and conventional classroom instruction without examining the effectiveness of Jigsaw IV cooperative learning and Reversed jigsaw setting on Students' Performance in Organic Chemistry in Zaria Education Zone, Kaduna State. Based on these facts the present study examined the effects of Jigsaw VI cooperative learning strategy on secondary school students' Academic Performance in Organic Chemistry in Zaria, Kaduna State.

### **Objectives of the Study**

The objectives of the study are to:

- Examine the performance of secondary school students taught Organic Chemistry concepts using Jigsaw VI and reversed jigsaw cooperative learning strategy and those taught using Conventional Method Teaching (CMT)
- Determine the performance of male and female students taught Organic Chemistry concepts using Reversed jigsaw cooperative learning strategy

### **Research Questions**

The study addressed the following research questions.

- (i). Is there any difference in the performance of secondary school students taught Organic Chemistry concepts using Jigsaw VI and reversed jigsaw cooperative learning strategy and those taught using Conventional Method Teaching (CMT)?

- (ii). Is there any difference in the performance of male and female students taught Organic Chemistry concepts using Reversed jigsaw cooperative learning strategy?

### **Null Hypotheses**

The following null hypotheses were tested in the study.

- (i). There is no significant difference in the performance of secondary school students taught Organic Chemistry concepts using Jigsaw VI and reversed jigsaw cooperative learning strategy and those taught using Conventional Method Teaching (CMT).
- (ii). There is no significant difference in the performance of male and female students taught Organic Chemistry concepts using Reversed jigsaw cooperative learning strategy.

### **Methodology**

Quasi-experimental, non-equivalent pretest, post-test, control group design was employed for the study. The sample for study comprised one hundred and fifteen SS II Science students from three intact classes randomly selected from three public coeducation schools in Zaria Education zone, Kaduna State, Nigeria. The experimental groups I and II were taught using JigsawIV and Reversed Jigsaw Instructional Strategies respectively while the control group was taught using the conventional teaching method.

### **Population of the study**

The population of this study comprised of all public co-educational Senior Secondary Schools (SS-II) Students offering Chemistry as a subject in Zaria Education zone. There are eleven senior secondary schools with a total of 979 students, out of which 579 students are males and 400 students are females.

### **Sample and Sampling Technique**

Six co-education schools (6) were initially selected by the simple random sampling out of the eleven (11) co-education schools in Zaria Educational Zone namely: GSS Aminu, Jukun, GSS Magajiya, GSS Gyalesu GSS Dakachi, GSS Likoro and GSS Tudun Jukun. These schools were pretested on a multiple-choice Organic Chemistry Performance Test (OCPT) which was an instrument developed by the researcher for the study. The result obtained was subjected to the analysis of variance (ANOVA) and Scheffe's test to determine the student's ability and schools that are academically equivalent. Consequently, two schools were then selected by simple random sampling from the three schools found to have equivalent ability. They are GSS

Dakaci and GSS Magajia (taken as the experimental school I and II) and GSS Karaukarau (as the control school). The sample for the study which comprised I. 38 students (male = 20 and female = 18) and II. 40 students (male = 19 and female = 21) for the experimental group and 41 students (male = 22 and female = 20) for the control group. Hence, the total number of students for the study was 118 (male = 61 and female = 59) which is in accordance with the central limit theorem by Tuckman (1975) who recommended a minimum of 30 subjects is viable for quasi-experimental research.

### **Instrumentation**

Organic Chemistry Performance Test (OCPT) was developed and used to ascertain the students' academic performance in Organic Chemistry concepts.

### **Validity of the Instrument**

The validity of OCPT was established by three Senior Lecturers with Ph.D. qualification and above in the Department of Science Education, Ahmadu Bello University, Zaria and one senior lecturer with a Ph.D. qualification at the Department of Chemistry, Faculty of Physical Sciences, Ahmadu Bello University Zaria, to judge the relevance, correctness, suitability, clarity, readability, unambiguity and completeness and so on, of the items in consideration of the research objectives and null hypotheses as well as the respondents. Question 27 of OCPT was recast from; The addition of mineral acids to alkenes results in a product with the negative part of the acid bonded to the carbon atom that holds the lowest number of hydrogen atom. This statement is in accordance with: - to; The addition of mineral acids to alkenes results in a product with the nucleophile bonded to the carbon atom that holds the lowest number of hydrogen atom. This statement is in accordance with:

### **Reliability**

The reliability of OCPT was found to be 0.81 when the test-retest method was observed and the result subjected to the Cronbach Alpha.

### **Results**

**The results are presented based on the research hypotheses:**

**H<sub>01</sub>:** There is no significant difference between the mean performance scores of students taught Organic Chemistry using the Jigsaw IV and reversed Jigsaw Cooperative Learning Strategy and those taught using the Conventional Method of Teaching among SS II Students in Zaria Educational Zone.

Table 1: Result of Analysis of Covariance of Chemistry Students' Taught Organic Chemistry using JigsawIV, Reversed Jigsaw and Conventional Teaching Method.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	13091.871 <sup>a</sup>	3	4363.957	99.620	.000
Intercept	26432.692	1	26432.69	603.40	.000
Pretest	850.078	1	850.078	19.405	.000
Sample	12347.359	2	6173.679	140.93	.000
Error	4993.892	114	43.806	2	
Total	93748.000	118			
Corrected Total	18085.763	117			

Table 1 shows that the ANCOVA test is  $F = 140.932$ ,  $p$ -value of 0.000 which is  $< 0.05$  alpha level of significance. This implies that there is a significant difference in the performance means scores of Chemistry students exposed to JigsawIV, Reversed Jigsaw instructional strategies and the Conventional Teaching method. Therefore, the hypothesis was rejected.

**H<sub>02</sub>:** There is no significant difference between the mean performance scores of male and female Students taught Organic Chemistry using Reversed Jigsaw Cooperative Learning Strategy in Organic Chemistry.

Table 2: t-test Analysis of Mean Performance Scores of Male and Female Students Taught using reversed Jigsaw Cooperating learning Strategy

Sex	N	Mean	Std. Deviation	<i>t-cal.</i>	<i>df</i>	<i>P value</i>	Remark
Male	21	32.95	9.217				
				0.559	38	0.177	*NS
Female	19	31.42	7.981				
Total	40						

Significant at  $P \leq 0.05$ , \*NS= Not significant



Table 2, shows that there is no significant difference in the posttest scores of male and female Chemistry students taught Organic Chemistry concepts using Jigsaw IV Cooperative Learning Strategy. This is simply because the *t-cal.* which is 0.559 and *p*-Value of 0.177 which is greater alpha value of 0.05 level of significance. Therefore, the null hypothesis which states that 'there is no significant difference in the mean achievement scores of male and female students taught Organic Chemistry concepts using Reversed Jigsaw Cooperative Learning Strategy' is hereby retained.

### Discussion

Findings from the study have revealed a significant difference between the academic performance of Chemistry students in JigsawIV, Reversed Jigsaw Cooperative learning strategies and conventional teaching method in favour of the two instructional strategies. This result indicates that the strategies are more effective in enhancing Chemistry students' academic performance than the conventional demonstration method. The findings of the study are consistent with the findings of (Heeden, 2003; Gambari & Yusuf, 2015; Samuel, 2018 and Isa, 2018 ), who in their various researches reported that students taught using JigsawIV, Reversed Jigsaw and other cooperative instructional strategies achieved better academically than those taught using the conventional methods.

The results of the analyses related to the hypothesis two indicated no significant difference in the performance of male and female students taught Organic Chemistry using Reversed Jigsaw cooperative learning strategy. This finding is in line with that of Ajaja and Eravwoke (2010); Yusuf, *etal* (2015); Timayi *et al* (2015) who individually found out that there is no gender difference in the academic performance of male and secondary school students exposed to Jigsaw IV Cooperative Learning Strategy. The finding is however in disagreement with that of Olson in Muhammad and Isa (2018) which reported that females performed better than males students when taught mathematics using Jigsaw II cooperative learning. This perhaps was due to the fact that the study was carried out at Western Australia University; perhaps students were not grouped into heterogenous groups of male female so as to enhance interactive effect of male and female students in the jigsaw groups. That might be the reason why the female students performed significantly better than their counterpart.

### Conclusion

The findings of this study revealed that JigsawIV and Reversed Jigsaw instructional strategies have significant effect on students' academic performance in Organic Chemistry.

### Recommendation

Based on the findings of this study, it was recommended that; Chemistry teachers should incorporate JigsawIV and Reversed Jigsaw instructional strategies into the teaching of Chemistry in senior secondary schools in Kaduna State and Nigeria at large.

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