EFFECT OF JIGSAW IV LEARNING STRATEGY ON PRIVATE SECONDARY SCHOOL STUDENTS' ACHIEVEMENT IN HYDROCARBON IN BICHI EDUCATION ZONE, KANO STATE, NIGERIA

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Abstract

This study investigated the effect of Jigsaw IV learning strategy on private secondary school students' achievement in hydrocarbon in Bichi Education Zone. The study used quasi-experimental non-randomized, pre-test, post-test design. Two research questions and two hypotheses were raised and tested at P≤0.05 level of significance. Hydrocarbon Achievement Test (HCAT) with reliability coefficient of 0.81 was used for data collection. The independent t-test was used to determine the main effects of jigsaw IV learning strategy on group achievement and gender. The results showed a significant effect on students' achievement but no significant effect of gender on the hydrocarbon concept's achievement. The findings revealed that the students taught hydrocarbon using jigsaw IV learning strategy out-performed their counterpart taught the same concept using lecture method and both the male and female students in the experimental group improved their achievement in which no significant difference was observed after the treatment. Jigsaw IV learning strategy had significant effects on students' achievement. Gender differences with respect to the effect of jigsaw IV learning strategy on achievement was not significant. Therefore, chemistry teachers should be encouraged and trained in the use of jigsaw IV learning strategy through organizing seminar, workshops, and conferences by educational administrators, state and federal ministry of education.

Keywords: Hydrocarbon, Jigsaw IV Learning Strategy and Achievement

Introduction

Science has an impact on human lifestyle by giving humans ways to lessen the hardships of existence on Earth. Science has a big impact on people's lives as well as the country as a whole. In general, science is described as a collection of information that is obtained by methodical experimentation and observation (Ezeudu, 2011). However, Science educators use educational ideas and scientific procedures to teach science. Science comprises of three major subjects such as biology, chemistry and physics.

Chemistry is the study of the composition, properties, and uses of matter. It looks into the laws governing the changes that matter undergoes (Osei, 2013). The demand for labor in a nation is largely influenced by the field of chemistry, including that of doctors, engineers, pharmacists, farmers, and scientific instructors. Nigeria now needs this kind of labor to advance technologically, achieve economic independence, and build other infrastructures and social amenities that it has long desired. Hence, chemistry is split into several branches each having its application to human life such as physical, analytical, inorganic, Biochemistry and Organic chemistry.

Organic chemistry referred to be the term used to describe the study of chemical substances found in living things, such as proteins, carbohydrates, lipids, oils, and enzymes. Except for the carbon oxides, carbonates, and cyanides present in coal and crude oil, the word is now defined as the study of carbon compounds (Isah & Sarah, 2021). Many more organic compounds are still awaiting discovery despite

the identification of over two million already (Ojokuku, 2017). The unique characteristics of carbon, such as catenation, tetravalency, and bonding with other elements including nitrogen, halogen, oxygen, and sulfur, are responsible for the vastness of both manufactured and natural organic molecules (Sakodie, 2013).

Organic chemistry, which covers a wide range of topics such hydrocarbons, alkanol, alkanal, alkanoic acids, esters, amine, and amide, among others, takes up a sizable amount of the secondary school curriculum. The Senior Secondary Certificate chemistry examination, which is given by the National Examination Council (NECO) and the West African Examinations Council (WAEC), also requires organic chemistry as a subject.

Organic chemistry has become more important in secondary school general education, which has impacted courses at higher education institutions. There are two main classes of organic compounds in organic chemistry: hydrocarbons and non-hydrocarbons. Hydrocarbons are compounds that only contain carbon and hydrogen. Alkanes, alkenes, and alkynes are examples of hydrocarbons (Aliphatic) that were the focus of this study. They can be found in coal, natural gas, and petroleum (crude oil) naturally.

Despite the subject's significance and the requirement that it be taught in schools, there are a number of issues with chemistry education. Several issues include the overuse of the lecture approach (Yusuf & Umar, 2019), the abstract nature of the subject, variables pertaining to students and teachers, the complexity of the concepts, and teaching chemistry without the use of instructional resources (Nnoli, 2014). This circumstance has facilitate research in the field of science education to look at alternate strategies for raising students' chemistry achievement levels while using approaches that make the material easier to understand and enable meaningful learning.

One learning strategy under cooperative learning is jigsaw, in which the lesson's content is broken into separate parts and then shared with groups of students. These students then explain their parts to one another, completing the jigsaw group as a whole (Aronson, 2008). Students use the Jigsaw strategy, which breaks down concepts into manageable segment. They are grouped into small groups of five to six people, called Jigsaw groups. Since expert groups consist of all the students with the same topic or segment, each student in the Jigsaw group is assigned a segment to concentrate on. After the lesson, the students reconvene in their Jigsaw groups, where they each give the other students in the group a quick summary of the topic they are studying. After that, they take the test alone, without the assistance of the other group members. The group scores are created by adding the scores of each individual member to decide which group is the best (Achor & Wude, 2014).

Conversely, we provide a variety of jigsaw cooperative learning approaches, such as reverse jigsaw, subject jigsaw, jigsaw I, jigsaw II, jigsaw III, and jigsaw IV. The latter was chosen by the researcher due to its distinctive features, which include tests, an overview, and teacher-led re-teaching of previously missed material. Jigsaw assesses both individual and group learning at various learning levels. The last two reverse and subject jigsaws are reserved for higher classes that concentrate on students' interpretations, such as perceptions and judgments, while the first four jigsaws I, II, III, and IV concentrate on the learners' understanding of the subject matter. Academic achievement has been found to be more significant by the use of jigsaw IV learning strategy (Jamilu, Iliyasu, Shehu & Vincent, 2022, Isah & Sarah, 2021, Isah & Muhammad, 2019). Hence, this study intends to investigate the effect of jigsaw IV learning strategy on private secondary school students' achievement in hydrocarbon in Bichi Education Zone.

According to Adediwura and Tayo (2007), academic performance is the knowledge and abilities

acquired in a subject determined by test and exam results or grades given by the subject teachers. Fakayode (2009) makes reference to the degree to which students achieve their short- and long-term educational goals. Usman (2010) points out those instructional strategies like lecture, discussion, and demonstration that prevent students from actively participating in the course may be to blame for the low performance levels observed in the sciences. According to Sani (2007), academic achievement is the attainment or proficiency of performance in a certain skill or set of information. Chandra and Shashi, (2020) investigates on the effect of jigsaw II strategy of cooperative learning and achievement in Biology and the result shown that the students' achievement were enhanced using jigsaw II cooperative learning strategy. According to Jamilu, Iliyasu, Shehu, and Vincent (2022), when students use the Jigsaw IV learning approach, they actively participate in the learning process, which makes the learning permanent and irrespective of students' gender.

Global interest in and disagreement over the gender disparity in students' performance in math and science have been raised (Stoet & Geary, 2013). Gender has been found to be one of the factors influencing students' achievement in the sciences at the senior secondary school level. Olson (2002) discovered that female students fared better than male students when science and math were taught through cooperative learning. According to Sadker in Lakpini (2006), male students received more criticism from teachers than female students, which affected their performance in the sciences. However, Khairulanuar, Nazre, Sairabanu, and Norasikin (2010) found that male students outperformed female students in mathematics in terms of gender differences. The present study tends to investigate the effect of jigsaw IV learning strategy on private secondary students' achievement in Bichi Education Zone.

Statement of the Problem

Inadequate understanding of topics like hydrocarbons poses a risk to students aspiring to excel in chemistry and similar courses at postsecondary educational institutions. It follows that in order to improve students' comprehension of hydrocarbons; chemistry lessons should be delivered using interactive methods such as jigsaw IV learning strategy. However, the majority of chemistry teachers in senior secondary schools used the lecture approach, which contributed to the failure of the students (Yusuf & Umar, 2019).

Even so, the interactions between "Teacher and Student" and "Student and Learning Material" receive the majority of attention in our educational system. But in any educational setting, there are other sorts of engagement besides these two. "Student-Student interaction" is the interaction that has the biggest impact on learning. Therefore, the researcher aimed to investigate how students' achievement and retention in hydrocarbon were impacted by the jigsaw IV learning strategy. Cooperative learning strategies have been the subject of several researches. Peer tutoring improves student performance, according to Sabitu's (2015) research on the impact of the practice on students' academic performance and confidence in redox reactions in Katsina state. Additionally, Isah and Sarah (2021) looked at how the Jigsaw IV cooperative learning strategy affected students' perceptions of organic chemistry topics in the Zaria Education Zone and came to the conclusion that these ideas were well-understood by the students. In view of the above no research was conducted in hydrocarbon in private secondary schools. Thus, the aim of this study is to ascertain how the Jigsaw IV learning strategy affects the academic achievement of private secondary students in hydrocarbon in the Bichi Education Zone.

Objectives of the Study

This study aims to ascertain the effect of the jigsaw IV learning strategy and the lecture method on the achievement of private secondary students in hydrocarbon in the Bichi Education Zone. Specifically, the study will look at the following:

1. Examine the mean achievement of students taught hydrocarbon using the jigsaw IV learning strategy versus those taught with the lecture method;

2. Find out the mean achievement of male and female students taught hydrocarbon with the jigsaw IV learning strategy;

1.4 **Research Questions**

The study's goal led to the formulation of the following research questions:

1. How does the mean achievement of students taught hydrocarbon using the Jigsaw IV learning technique differ from that of students taught hydrocarbon using the lecture method?

2. How does the mean achievement of students taught hydrocarbon using the Jigsaw IV learning technique differ between male and female students?

1.5 **Hypotheses**

The subsequent null hypotheses were examined at the significance level of $P \leq 0.05$ alpha.

HO_1: The achievement scores of students taught hydrocarbon using the Jigsaw IV learning technique and those taught using the lecture method do not significantly differ from one another.

HO_2: The achievement scores of male and female students taught hydrocarbon using the Jigsaw IV learning technique do not significantly differ from one another.

Methodology

The study used a quasi-experimental research design. Non-randomized pre-test, post-test and control group design. Intact classes were used. All SSII chemistry students in private secondary schools of Bichi Education Zone made up the population. The population comprises of students drawn from four (4) private secondary schools in the zone. The total population of SSII students was one hundred and eighty four students (184). Sixty-five (65) SSII chemistry students from private secondary schools made up the study's sample; 34 boys and 31 girls were chosen from the two (2) schools, making the sample viable for the research. This is in accordance with Tuckman (1975), Frankel and Wallen (2000), and Sambo (2008) recommendations that an experimental study of this kind requires a sample size of at least 30 students.

A simple random sampling technique was used to choose the two schools. The sample schools were chosen by writing the names of the four (4) schools on a piece of paper, squeezing it, placing it in a container, and picking one piece of paper at a time. Each time, a piece is pick, the container was reshuffle before the next is pick. Any school whose name appeared on the paper was taking as one of the two schools that served as sample. The process was repeated until the two schools were selected. However, the schools were randomly assigned as experimental and control schools.

Hydrocarbon Achievement Test (HCAT) was adopted from Jamb, Waec and Neco pass questions and is made up of two sections A and B. Section A is made up of personal data of the subject, which comprises of the name, school, class and gender. Section B, was used to elicit the achievement and retention responses of the subjects on hydrocarbon. The test items met the objective of the lesson used for the treatment. HCAT is a thirty multiple choice items. Each stem of the items has four options A-D. It is developed to cover the content of organic chemistry concept such as Hydrocarbon, functional group/homologues series, alkanes, alkenes and alkynes; taught to the subjects during the treatment period. HCAT was scored on a total of 30 marks. All the 30 marks items arrange by implication at all levels (correct and wrong) were scored 30 marks since the two level options are assigned with numerical values correct (1) and wrong (0). Thus each item has the multiple choices if answered correctly scores one mark yielding a total of 30 marks.

These items were generated around the first four levels of cognitive domain (i.e knowledge, comprehension, application, and analysis) and excluded the last two categories of cognitive domain (i.e evaluation and synthesis) as categorized by Bloom (1956). These two categories which were considered "higher level" objectives could not be adequately measured by multiple choice test items (Olasehinde and Ibrahim, 2017). Each category has the apportioned number of items on the test according to its importance in science. Knowledge carried a higher portion of the test followed by comprehension, application and analysis.

Content and face validity of the instrument was established by two experts in the Department of Science Education and one expert also in the Department of Applied Chemistry Federal University Dutsin-Ma, to moderate the relevance, correctness and completeness of the items in consideration of the research objectives and null hypotheses as well as the respondents. The instrument was adequately rich and highly recommended to be used as committed by the validators.

The test-retest reliability approach was used to calculate the instrument's reliability coefficient. After a two-week period, the same respondents were given the instrument again. To establish the validity of the instruments, the results of the two tests were compared. Included in the sampled schools was not the school and students used to determine the instrument's dependability. Twenty five (25) students sampled were tested and then re-tested. The reliability coefficient of the instrument was determined using (PPMC) and the value was found to be r = 0.81. This value suggests that the questions were reliable and would measure what it is designed to measure.

Research Questions were answered using means and standard deviations while the hypotheses were tested using independent t-test at 0.05 level of significance.

Results

Research Question One

How does the mean achievement of students taught hydrocarbon using the Jigsaw IV learning technique differ from that of students taught hydrocarbon using the lecture method?

Table 1: Mean and Standard Deviation of Students' Achievement of Experimental and Control Groups

Group	N	Mean	Standard Deviation	Mean difference
Experimental	41	21.93	3.538	
				4.97
Control	24	16.96	4.787	

Table 1 Showed that the students in the experimental group obtained a mean of 21.93 and standard deviation of deviation of 3.538. The control group obtained a mean of 16.96 and standard deviation of 4.787. The mean difference of 4.97 was obtained. This implies that the students exposed to jigsaw IV learning strategy seem to have achieved higher than their counterparts exposed to lecture method.

Research Question Two

How does the mean achievement of students taught hydrocarbon using the Jigsaw IV learning technique differ between male and female students?

Table 2: Mean and Standard Deviation of Students' Achievement in Experimental Group

Gender	N	Mean	Standard Deviation	Mean difference
Male	20	21.95	3.546	
				0.05
Female	21	21.90	3.618	

Table 2 showed that the male students obtained a mean of 21.95 and standard deviation of 3.546. The female students obtained a mean of 21.90 and standard deviation of 3.618. The mean difference of 0.05 was obtained. This implies that the male students seem to have achieved higher than their female counterparts both exposed to jigsaw IV learning strategy.

Hypotheses Testing

HO_1: The achievement scores of students taught hydrocarbon using the Jigsaw IV learning technique and those taught using the lecture method do not significantly differ from one another.

Table 3: Independent t-test Post-test Comparison of Mean Achievement Scores of Experimental (jigsaw IV) and Control (lecture method) Groups

Group	N	Mean	Std Dev.	Df	t-value	P-value	Remark
Experimental	41	21.93	3.538	63	4.786	0.00	Significant
Control	24	16.96	4.787				

Significant at P≤0.05.

The finding in Table 3 indicates that the academic performance of the students in the experimental and control groups differs significantly. The null hypothesis is rejected since the observed p-value was 0.00, which is less than the 0.05 level of significance (P≤ 0.05).

The significant difference was in favor of students exposed to jigsaw IV learning strategy as revealed in their mean scores.

HO_2: The achievement scores of male and female students taught hydrocarbon using the Jigsaw IV learning technique do not significantly differ from one another.

Table 4: Independent t-test Post-test Comparison of Mean achievement Score of Male and Female Students Taught Hydrocarbon Using Jigsaw IV Learning Strategy

Gender	N	Mean	Std Dev.	Df	t-value	P-value	Remark
Male	20	21.95	3.546				
				39	0.40	0.968	Not significant
Female	21	21.90	3.618				

Not significant at P≤0.05.

Because the p-value in Table 4 is 0.968, it might be concluded that there is no significant difference in the achievement of males and females in hydrocarbon using the Jigsaw IV learning approach. The null hypothesis is not rejected since the critical p-value of 0.968 is greater than the alpha value at the 0.05 level of significance (P≤ 0.05). Therefore, statistically speaking, there is no difference between the two means.

Discussion of Findings

The findings of this study show the effect of jigsaw IV learning strategy in the teaching and learning of hydrocarbon in private secondary schools. The study find out the mean difference between the students taught hydrocarbon through jigsaw IV learning strategy and those taught the same topic using lecture method. However, the study compared how gender influenced students' scores in jigsaw IV

classes. Finding from this study shows that jigsaw IV learning strategy has significant impact on students' achievement in hydrocarbon the difference scores shown on Table 1 and 3 indicated that, those students taught hydrocarbon using jigsaw IV learning strategy achieve significantly higher than those taught the same concept using lecture method. This is in line with findings of Isah and Muhammad (2019), who investigates on the effect of jigsaw IV teaching strategy on students' performance in organic chemistry and the result shown a clear difference in the mean scores in favour of the experimental group, indicating the effectiveness of jigsaw IV learning strategy. The study also compared the effect of jigsaw IV learning strategy between male and female students taught hydrocarbon using jigsaw IV learning strategy and the findings revealed that there is no significant difference between male and female students based on the result obtained from Table 2 and 4. This shows that jigsaw IV learning strategy is gender friendly. The study agree with findings of Ali, Bichi, Mari and Lakpini (2018), who investigates the efficacy of jigsaw learning model on academic performance of polytechnic students in which both sexes were maximally benefited from the use of jigsaw learning model.

Conclusion

The result shows that jigsaw IV learning strategy improved students' achievement in hydrocarbon. Also, it shows that there is no significant difference between male and female students' achievement when jigsaw IV is used in learning hydrocarbon.

Recommendations

The following recommendations were made based on the findings of the study:

i. Chemistry teachers are advised to include this Jigsaw IV strategy in their lesson plans.

ii. Seminars, workshops, conferences, and in-service training should be organized for science educators, federal and state ministries of education, and the senior secondary school administration board in order to educate and prepare teachers for the implementation of the Jigsaw IV learning approach.

iii. The science methods course content should be integrated with the Jigsaw IV learning strategy

y by teacher training institutions. By doing this, prospective chemistry teachers will be properly trained in the application of the Jigsaw IV learning technique.

iv. Since gender bias in chemistry is eliminated by the Jigsaw IV learning approach, it can also be eliminated in other scientific and technical topics.

v. The authors of the textbook ought to include the jigsaw IV learning approach.

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