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# Effect of Jigsaw Learning Strategy on Biology Students' Inclusive Learning Attitude and Achievement in Human Respiratory System: A Small Scale Study of Government Secondary School Abua, Rivers State

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## ABSTRACT

*The study investigated the effects of jigsaw learning strategy on biology students' inclusive learning attitude and achievement in human respiratory system in Government Secondary school Abua, in Abua/Odual Local Government Area of Rivers State. The pre-test post-test non-equivalent control group of quasi-experimental research design was adopted. The population was all the 227 biology students Government Secondary School, Abua. The sample for the study was the 75 SS2 students purposively selected. The study was carried out with four research objectives, four research questions and four hypotheses. A teacher made test titled Human Respiratory System Achievement Test and a structured questionnaire titled Effects of Jigsaw Learning Strategy on Students' Inclusive Learning Attitude Questionnaire were the instruments used. Both instruments were validated by experts in Science Education. The reliability index of the achievement test and the questionnaire were 0.85 and 0.78 respectively. The research questions were analyzed with the mean while the hypotheses were tested using the z-test at 0.05 level of significance. It was discovered that students who were taught respiratory system with the jigsaw instructional approach performed better and again they have a better attitude of inclusiveness in the class than their peers who were taught same topic but with lecture method. Based on the findings, it was recommended that both pre-service and in-service biology teachers should be trained properly to acquire appropriate skills and competence needed for jigsaw instructional approach.*

**Keywords:** Jigsaw, Learning Strategy, Inclusive Learning, Attitude, Achievement, Human Respiratory System.

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## INTRODUCTION

The major objective of every classroom instruction is making sure that students understand the concept being taught. This to a greater extent depends on the teacher. The quality of instruction received by the students depends on the knowledge of the teacher (Nwankwo & Okigbo, 2021). This implies that there is a strong positive relationship between teachers' knowledge of subject matter and the level of subject knowledge achieved by their students. Therefore, for any subject to be effectively taught there should be trained and qualified teachers using appropriate and effective instructional strategies. This implies that for the effective study of biology, teachers have to select appropriate instructional methods that will appeal to both the students, arouse their interest and enable them achieve excellent performance. The traditional pedagogical practices are predominately being practiced in Nigerian schools where the teacher dominates the class (teacher-centered) or sometimes use demonstration activities to verify the factual knowledge given in the textbook. These methods failed to ensure quality education according to the need of contemporary scenarios

(Ezeaghasi & Uchechukwu, 2021). A major concern in science teacher education is the development of teachers' pedagogical content knowledge for improving classroom practice and students learning. Preliminary observation has proven that Biology teachers use conventional lecture method to teach most of the topics in Biology, giving large notes and assignments meant to keep the learners busy without positive impact on their cognition and affection (Chukwu & Arokoyu, 2019).

The goal of modern respiratory biology should be to understand biological connectivity and complexity by viewing an organism as a series of interconnecting systems from molecule to ecosystem. According to Steven and Warren (2007) the future of science in general and biology in particular, lies in disciplinary networking: combining the results of traditional disciplines to better understand the whole. Because of its universality, Respiratory Biology can best provide this bridge and improve interdisciplinary studies in biology generally. The knowledge of Biology has help immensely in researching solutions to vital concerns such as increasing world food supply, controlling pest and diseases, environmental protection and studying the biology of certain microorganisms such viruses causing global pandemic such as the corona virus. It is worth noting that at the senior secondary level, Biology is taught to students as if they will all be Science students at the University (FRN, 2014). Interestingly, it is a popular science subject among students and its popular nature among other science subjects has made it a distinct choice for most students. Today, Biology pervades literally every field of human endeavor and plays a fundamental role in educational advancement (Mberekpe, 2013). It is a key to economic, intellectual, sociological, human resource development and well- being of any society. It is a very important science subject and stands as the bedrock upon which are based many other science courses like Medicine, Pharmacy, Nursing, Biochemistry, Genetic, Agriculture etc., that are of great economic importance to a nation. Besides, the importance of Biology to mankind as science of life, it is one of the science subject mostly preferred by many students in the secondary schools because it has less mathematical calculations unlike Physics and Chemistry and deals with non-abstract things (Abimbola cited in Mohammed & Samuel, 2022).

Inclusion in education has to do with ensuring every child, no matter what their individual needs or barrier to learning, has equal access to learning and the same opportunities to achieve. Inclusion in schools or classroom learning does not limit itself to just providing additional support to children with special needs but creating environment of learning for all pupils, whether they have disability, speak English as an additional language, are a member of a minority community, come from a low income family or find it harder to learn and achieve for other reasons (Ryan, 2022). Inclusiveness tends to ensure that learners with diverse needs and preferences have equal opportunities in accessing learning resources, services and experiences in general (Florian & Linklater in Navarro, Zervas, Gesa and Sampson 2016). Disparity in the learning pace of students most times make teachers more interested in the brilliant students thereby increasing the gap existing amongst below average, average and above average students. Some approaches promote inclusiveness among students which tends to stir up a culture of accommodating and making all learners participants (Makoelle, 2014). Students' inclusiveness can be improved when effective learning approaches are used in the classroom. For the purpose of this study, the jigsaw learning

approach was used.

Jigsaw learning strategy refers to fragmenting a concept and allowing each handler of the fragments to depend on the others to achieve a whole concept. It involves organizing classroom activity that makes students dependent on each other to succeed. It breaks classes into groups that each assemble a piece of an assignment and synthesize their work when finished. According to Ojekwu and Ogunleye (2020), the jigsaw learning strategy was developed by Elliot Aronson and colleagues in 1978. The essence of the learning strategy was to reduce inter-racial segregation and foster cooperation among the students. In order words, it promotes inclusiveness in education. According to Slavin in Ezeaghasi and Uchechukww, (2021), in Jigsaw practice, the students act interdependently to assist and learn the academic content from each other. This is based on the fact that Jigsaw learning strategy revolves around task specialization. Each student is assigned a specific task of the lesson module to work on, after which they are expected to teach the other members of the group. Jigsaw learning strategy is an instructional strategy that requires students to work as a team in a group of 4, 5 or 6 students. Here, a topic is shared into sub - topics equal to the number of students in each group. Each student in a group is given a sub-topic and is given a learning material relevant to his/her assigned portion of the topic to study for some moment. Members of the different groups who have studied the same material meet together to share information and solve the task. Their expert knowledge is shared with other members in the original home group. In this aspect, the students are expected to achieve a significant level of mastery of the lesson tasks assigned to them. Jigsaw based cooperative learning is a cooperative learning strategy in which lesson contents are subdivided into different parts of information and given to groups of students who would later explain to each other their parts and these results in the whole jigsaw process to be completed. Appropriate teaching strategies have a profound influence on students' performance in diverse subjects. According to Aronson in Bello (2016), jigsaw aids in the following:

i. It helps in building comprehension
ii. It encourages cooperative and inclusive learning attitude among students
iii. It helps improve listening, communication, and problem-solving skills.

In a nutshell, this learning strategy does not only improve the achievement level of students on concepts but also bridges the gap between some disparities among students which may have been caused by socioeconomic status, race, physical impairment, and so on.

**Statement of the Problem**

The underperformance of Biology students in West African Senior School Certificate Examination in Nigeria has become a worrisome situation that calls for urgent attention (Chukwu & Arokoyu, 2019). Cimer (2012) also noted that some concepts or topics including respiration in biology are perceived to be difficult to learn by students in secondary schools. Students' poor academic performance to some extent is traceable to inappropriate instructional strategies used by the teachers which is also connected to students' poor attitude of inclusiveness and part of the learning process towards learning biology (Mukuka, 2019). According to Talton and Simpson cited in Mukuka (2019), students' attitude (inclusiveness) towards learning is influenced by performance, motivation and teachers' philosophies which render into

teaching methodologies. Therefore, this study hinges on the determination of the effects of the use of the Jigsaw learning strategy on students' achievement and if the strategy could influence students' inclusive learning attitude in human respiratory system and biology at large.

**Purpose of the Study**

This study was aimed at investigating the effect of jigsaw learning strategy on students' inclusive learning attitude and achievement in respiratory system, a concept in biology. But specifically, the following are the objectives of the study:

1. To find out if there is difference in student's inclusive learning attitude when taught human respiratory system with jigsaw learning strategy.
2. To find out if there is difference between male and female inclusive learning attitude when taught with jigsaw learning strategy.
3. To determine the difference in students' performance in human respiratory system when taught with jigsaw learning strategy and lecture method.
4. To find out if there is difference between male and female students performance in human respiratory system when taught with jigsaw learning strategy.

**Research Questions**

The following are the research questions raised to guide the study:

1. What are the mean response of students on inclusive learning attitude towards biology when taught respiratory system using the jigsaw learning strategy and lecture method?
2. What is the difference between male and female student' inclusive learning attitude towards biology when taught with jigsaw learning strategy?
3. What is the mean difference in the achievement of students in human respiratory system when taught using the jigsaw learning strategy and the conventional lecture method?
4. What is the difference in the academic achievement of male and female students taught human respiratory system using jigsaw learning strategy?

**Hypotheses**

The following null hypotheses were postulated for the study:

1. Jigsaw learning strategy does not significantly affect students' inclusive learning attitude towards biology.
2. There is no difference between male and female student' inclusive learning attitude towards biology when taught with jigsaw learning strategy
3. There is no significant difference in the achievement of students taught human respiratory system using the Jigsaw learning strategy and those taught using the lecture method.
4. There is no significant difference in the achievement of male and female students taught human respiratory system with jigsaw learning strategy.

**METHODOLOGY**

The study adopted the pre-test post-test non-equivalent control group of quasi-experimental research design. A quasi-experimental design according to Nwankwo in Adolphus and Omeodu (2016) is a study in which some threats to internal and external validity cannot be properly controlled because of unavoidable situations associated

with the study when human beings are used for experimental study. Quasi-experimental design was considered appropriate for the study because intact classes were used to avoid disruption of normal class lessons. In other words, already organized classes were used. The study was carried out with the Senior Secondary (SS1 – SS3) biology Students of Government Secondary School Abua, Rivers State. The study was a small scale study therefore SS2 which comprised of 75 students from two arms (A= 39, B=36) where purposively selected.

Two instruments were used for the study viz: A teacher made test titled Respiratory System Achievement Test (RSAT) and a structured questionnaire titled Relevance of Jigsaw Strategy on Students' Inclusive Learning Attitude Questionnaire (RJSSILQ). The achievement test consists of 30 multiple choice questions with four options lettered (A-D). It has one correct response and three distractors. Correct response carries one mark while incorrect response carries zero mark. While the questionnaire (RJSSILQ) consist of 9 items and was meant to measure students inclusive attitudes towards the study of biology. Four (4) likert rating scales of Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SA) were used and nominal value of 4, 3, 2, and 1 were attached. Both instruments were validated by three Science Educators in the department of Science Education while the reliability were determined using test retest method with the Pearson Product Moment Correlation Coefficient of 0.85 and 0.78 respectively. The two intact classes (A & B) formed the control and experimental group. Class A formed the control group while B formed the experimental group. The classroom teacher was briefed and asked to teach the concept of respiratory system to the control group with the normal traditional lecture method while the researcher used the jigsaw learning strategy in teaching the experimental group (form B). After which, both groups were administered same set of instrument and were retrieved immediately they finished answering the questions. For data analysis, Mean and Standard Deviationwas used to answer the researcher questions while the hypotheses were tested using the Z-test at 0.05 level of significance.

## RESULTS

### Research Question 1

What are the mean response of students on inclusive learning attitude towards biology when taught respiratory system using the jigsaw learning strategy and lecture method?

**Table 1**

*Mean Response of Students' Inclusive Learning Attitude Towards Biology When*

*Taught With Jigsaw and Lecture Method*

| S/N | Statement | Lecture Mean | Remark | Jigsaw Mean | Remark |
|---|---|---|---|---|---|
| 1 | Teachers' strategy helps me have a sense of belonging in biology classroom | 2.27 | Rejected | 2.95 | Accepted |
| 2 | The class teaching makes me always have something to offer in the classroom | 2.42 | Rejected | 3.02 | Accepted |
| 3 | The teachers' strategy promotes trust and mutual respect as students depend on each other | 2.41 | Rejected | 2.91 | Accepted |
| 4 | The teaching strategy makes biology lessons easier for me | 2.50 | Accepted | 3.45 | Accepted |
| 5 | This method makes me to be open minded | 2.01 | Rejected | 2.81 | Accepted |
| 6 | Because of the communication amongst students, social skills are developed | 2.11 | Rejected | 2.92 | Accepted |
| 7 | It promotes self confidence and high self esteem | 2.33 | Rejected | 2.71 | Accepted |
| 8 | It makes me respect other students view | 2.41 | Rejected | 2.65 | Accepted |
| 9 | This learning strategy makes me see every student in my class as equal | 2.21 | Rejected | 2.69 | Accepted |
| | **Grand Mean** | **2.28** | **Rejected** | **2.90** | **Accepted** |

The result in Table 1 shows the mean response of students' inclusive learning attitude towards biology. A grand mean of 2.28 for students exposed to lecture method (control group) and 2.90 for students exposed to jigsaw learning strategy. From the table, it can be deduced that students exposed to the jigsaw learning strategy have a better inclusive learning attitude towards the study biology.

**Research Question 2**

What is the difference between male and female student' inclusive learning attitude towards biology when taught with jigsaw learning strategy?

**Table 2**

*Mean Response on Effect of Jigsaw Learning Strategy on Students' Inclusive Learning Attitude Towards Biology Based on Gender*

| S/N | Statement | Male | Remark | Female | Remark |
|---|---|---|---|---|---|
| 1 | Teachers' strategy helps me have a sense of belonging in biology classroom | 3.09 | Accepted | 2.80 | Accepted |
| 2 | The class teaching makes me always have something to offer in the classroom | 2.77 | Accepted | 2.74 | Accepted |
| 3 | The teachers' strategy promotes trust and mutual respect as students depend on each other | 2.76 | Accepted | 2.72 | Accepted |
| 4 | The teaching strategy makes biology lessons easier for me | 2.69 | Accepted | 2.69 | Accepted |
| 5 | This method makes me to be open minded | 2.98 | Accepted | 2.69 | Accepted |
| 6 | Because of the communication amongst students, social skills are developed | 2.74 | Accepted | 2.79 | Accepted |
| 7 | It promotes self-confidence and high self esteem | 2.91 | Accepted | 2.91 | Accepted |
| 8 | It makes me respect other students view | 2.80 | Accepted | 2.84 | Accepted |
| 9 | This learning strategy makes me see every student in my class as equal | 2.74 | Accepted | 2.78 | Accepted |
| | **Grand Mean** | **2.84** | Accepted | **2.78** | **Accepted** |

The result in Table 2 above shows the male and female students mean response on inclusive learning attitude towards biology when taught with jigsaw learning

strategy with a grand mean of 2.84 for male students and 2.90 for female students. From the table, it can be noticed that there is no gender effect on their response on inclusive learning attitude towards the study biology.

**Research Question 3**

What is the mean difference in the achievement of students in human respiratory system when taught using the jigsaw learning strategy and the conventional lecture method?

**Table 3**

*Mean Score of Students Taught Respiratory System Using Jigsaw Learning Strategy and Lecture Method*

| Groups | N | Pre-test Mean | Post-test Mean | Mean gain |
|---|---|---|---|---|
| Control (lecture method) | 39 | 9.2 | 15 | 5.8 |
| Experimental (Jigsaw strategy) | 36 | 9.8 | 21.2 | 11.4 |
| **Mean Difference** | | **0.6** | **6.2** | |

Table 3 indicates that the mean score of the experimental (jigsaw strategy) and control (lecture method) group has a mean difference of 6.2 in favour of the experimental group which shows that the jigsaw learning strategy was effective. The mean gain is also higher (11.4) for the Jigsaw group than for the Lecture group with a mean gain of 5.8.

**Research Question 4**

What is the difference in the academic achievement of male and female students taught human respiratory system using jigsaw learning strategy?

**Table 4**

*Mean Score by Gender of Students Taught Respiratory System Using Jigsaw Learning Strategy*

| Groups | N | Pre-test Mean | Post-test Mean | Mean Gain |
|---|---|---|---|---|
| Male | 19 | 13.2 | 18.94 | 5.74 |
| Female | 17 | 12.49 | 18.33 | 5.84 |
| **Mean Difference** | | **0.71** | **0.61** | 0.10 |

The result from Table 4 has a post-test mean difference of 0.61 between male and female student in their achievement in human respiratory system when taught using the jigsaw learning strategy. The mean gain difference was also just 0.10.

**Hypothesis 1**

Jigsaw learning strategy does not significantly affect students' inclusive learning attitude towards biology.

**Table 5**

*z-Test Analysis on the Effect of Jigsaw Learning Strategy on Students' Inclusive Learning Attitude Towards Biology*

| Variable | N | Mean | SD | z-cal | z-crit | Decision |
|---|---|---|---|---|---|---|
| Control Group | 39 | 2.28 | 1.18 | | | |
| | | | | 2.16 | 1.67 | Rejected |
| Experimental Group | 36 | 2.90 | 0.95 | | | |

Table 5 indicates that the mean and standard deviation for control group were 2.28 and 1.18, while for experimental group were 2.29 and 0.95 respectively. The z-calculated value was 2.16, while the critical value was 1.67 at 0.05 level of

significance. This result shows that z-cal. is greater than the z-crit. which means that the null hypothesis was rejected. That is to say, there is a significant difference in the achievement of students when taught respiratory system with the traditional teaching method as compared to those taught with the jigsaw learning strategy.

**Hypothesis 2**

There is no difference between male and female student' inclusive learning attitude towards biology when taught with jigsaw learning strategy.

**Table 6**

*z-test Analyses on Male and Female Students Inclusive Learning Attitude Towards Biology When Taught Respiratory System Using Jigsaw Learning Strategy*

| Variable | N | Mean | SD | z-cal | z-crit | Decision |
|---|---|---|---|---|---|---|
| Male | 19 | 2.84 | 1.18 | | | |
| | | | | 0.16 | 1.69 | Accepted |
| Female | 17 | 2.78 | 1.08 | | | |

Table 6 above indicates that the mean and standard deviation for male students in the experimental group were 2.84 and 1.18, while that of female students in the same experimental group were 2.78 and 1.08 respectively. The calculated z value was 0.16, while the critical value was 1.69 at 0.05 level of significance. This shows that z-cal. was lower than z-crit. Therefore, the null hypothesis was accepted. This shows that there is no gender effect on students' inclusive learning attitude towards biology

**Hypothesis 3**

There is no significant difference in the achievement of students taught human respiratory system using the Jigsaw learning strategy and those taught using the lecture method.

**Table 7**

*z-test Analysis on Mean Scores of Student Taught Respiratory System With Traditional Teaching Method and Those Taught With Jigsaw Learning Strategy*

| Variable | N | Mean | SD | z-cal | z-crit | Decision |
|---|---|---|---|---|---|---|
| Lecture Method | 39 | 15.4 | 6.31 | | | |
| | | | | 4.44 | 1.67 | Rejected |
| Jigsaw Strategy | 36 | 21.2 | 5.08 | | | |

Table 7 indicates that the mean and standard deviation for control group were 15.4 and 6.31, while for experimental group were 21.2 and 5.08 respectively. The z-calculated value was 4.44, while the critical value was 1.67 at 0.05 level of significance. This result shows that z-cal. is greater than the z-crit. which means that the null hypothesis was rejected. That is to say, there is a significant difference in the achievement of students when taught respiratory system with the traditional teaching method as compared to those taught with the jigsaw learning strategy.

**Hypothesis 4**

There is no significant difference in the achievement of male and female students taught human respiratory system with jigsaw learning strategy.

**Table 8**

*z-test Analysis on Mean Scores of Male and Female Students Taught Respiratory System With Taught With Jigsaw Learning Strategy*

| Variable | N | Mean | SD | z-cal | z-crit | Decision |
|---|---|---|---|---|---|---|
| Male | 19 | 18.94 | 5.39 | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | 0.38 | 1.69 | Accepted |
| Female | 17 | 18.33 | 4.13 | | | |

Table 8 indicates that the mean and standard deviation for male students in the experimental group were 18.94 and 5.39, while that of female students in the same experimental group were 18.33 and 4.13 respectively. The calculated z value was 0.38, while the critical value was 1.69 at 0.05 level of significance. This shows that z-cal. was lower than z-crit. Therefore, the null hypothesis was accepted. This shows that there is no significant difference between male and female students taught respiratory system using jigsaw learning strategy.

## DISCUSSION OF FINDINGS

The findings from the study revealed that jigsaw learning strategy influenced students' inclusive learning attitude, and that there was a significant difference between the mean response of students taught respiratory system using the jigsaw learning strategy and those taught same topic in biology using the conventional lecture method. This implies that the jigsaw learning strategy as a type of cooperative learning strategy helps teachers to run an inclusive learning environment thereby making every student in the classroom no matter their social status or so very important. Findings from the study are consistent with that reported by Garrote, Felder, Krahenmann, Schnepel, Dessemontet and Opitz (2020) that teachers' pattern of teaching and classroom management affect students' social acceptance in the classroom.

Also, findings from the study revealed that jigsaw learning strategy is an effective strategy that has greater effect on the achievement level of students in respiratory system as a concept in biology. This study is in agreement with that of Chukwu and Arokoyu (2019) and, Ojekwu and Ogunleye, (2020) who reported similar findings in biology. The finding is also in line with that of Mohammed and Samuel (2022) who investigated the effect of jigsaw learning strategy on students' achievement in the cell and its environment.

Findings from this study show that gender has no effect on students' achievement in respiratory system and their inclusive learning attitude towards the learning of biology. The findings agree with that reported by Adolphus and Omeodu (2016) who affirm that the gender of students does not play any role learning. However, the finding is contrary to the findings of Nwagbo and Okoro (2012), who observed that the average scores of male students in biology were constantly higher than those of female students when taught with three different innovative methods.

## CONCLUSION

Based on the findings, it is therefore concluded that jigsaw learning strategy affects students' achievement in respiratory system, a concept in biology thereby increasing their performance level. Again, this learning strategy also helps in promoting students inclusive learning attitude towards the study of biology in general. It was concluded that the jigsaw learning strategy is gender-friendly which means both the male and female students performed equally.

## EDUCATIONAL IMPLICATION

From the findings of the study, the following implications stated below:

1. Teachers and curriculum planner be aware that jigsaw learning strategy has been shown to be effective compared to the traditional lecture method when it

comes to students' achievement and sense of inclusive learning attitude.

2. Also, the findings indicated that gender is not a significant factor in the achievement and of students in biology. The implication is that equal attention should be given to both male and female students during teaching and learning of biology.

**RECOMMENDATIONS**

1. Jigsaw learning strategy should be included in all their biology teaching methodology content by Teacher-training institutions so as to produce reputable biology teachers with sound knowledge of how to use Jigsaw learning strategy in teaching of biology for greater students' achievement.
2. In-Service Biology teachers should be adequately trained on effective steps for the implementation of Jigsaw learning strategy in their classrooms by organizing extensive seminars and workshops to help improving students' achievement in biology

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