

## EFFECT OF JIGSAW INSTRUCTIONAL STRATEGY ON STUDENTS' PERFORMANCE IN BASIC SCIENCE IN TARABA STATE, NIGERIA

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### ABSTRACT

The study explored the effect of jigsaw instructional strategy on students' performance in basic science in Taraba State, Nigeria. Three research questions were raised; three null hypotheses were formulated and tested at 0.05 level of significance. The study adopted a quasi-experimental research design. The population comprised all the 6288 students in upper basic II in Jalingo Education Zone. The sample size was 209 students from two sampled intact classes. Purposive and simple random samplings were used as sampling techniques. 91 students were in the experimental group and taught with jigsaw instructional strategy while 118 students were in the control group and learned through conventional instructional strategy. Basic Science performance test (BSPT) was used for data collection. BSPT was validated by three experts: two from science education and one from measurement and evaluation unit all from Taraba State University, Jalingo. Reliability index of BSPT was found to be 0.88 using Kuder Richardson 20 formula. Mean and standard deviation were used to answer all the research questions while Analysis of Covariance (ANCOVA) was used to test all the null hypotheses. The findings revealed that students taught using jigsaw instructional strategy showed significantly higher performance than their counterparts in the conventional instructional strategy ( $p < 0.05$ ). There was no significant effect of gender on performance ( $p > 0.05$ ). Similarly, there was no significant interaction effect of strategies and gender on performance ( $p > 0.05$ ). It was concluded that when learning through jigsaw instructional strategy enhances performance. It was recommended among others that basic science teachers should integrate this strategy into classroom instructions to improve students' performance in Basic Science.

**Keywords:** *Jigsaw, Conventional Strategy, Performance, Gender, basic science*

### INTRODUCTION

Education plays a pivotal role in the development of any nation, serving as the cornerstone for social, economic, and technological advancement. In Nigeria, as in many developing countries, there is a growing emphasis on improving the quality of education, particularly in the fields of science and technology. One of the ways of improving this quality is the enhancement of the teaching and learning process of science across all the levels of education; particularly, at the primary level where the learners are first introduced to science and technology. The primary education level is a critical stage in the Nigerian educational system, as it lays the foundation for future academic and career pursuits in these vital areas. Basic Science is designed to provide students with fundamental knowledge and skills in various scientific and technological disciplines. In the Nigerian educational system Basic Science which is the first form of science taught plays a pivotal role in laying this crucial foundation. This interdisciplinary subject aims to equip students with a broad understanding of scientific concepts and their practical applications in areas such as physics, chemistry, biology, and technology and this could be achieved only through effective teaching and learning of basic science. However, the teaching and learning of basic science have faced numerous challenges, one of which includes poor academic performance.

Students' performance is widely considered to be an important learning outcome and has initiated a lot of research studies. Students' academic performance, an important learning outcome, provides information about the extent to which the objectives of learning basic science are

attained. Aniekwe (2019) viewed performance as a test for the measurement and comparison of skills in various fields of academic study. Students' performance provides information on the extent to which a student has attained the criterion performance. Performance measurement is used for instructional, administrative, guidance counseling, and research purposes (Etuk et al., 2019). Most of the decisions and resolutions arrived at in an educational setting revolve round fostering positive performance for students. The goals, aims and objectives of teaching basic science will not be attained if students' performance is not encouraging. Notwithstanding, there is a trend of low performance of students in basic science especially as documented in their previous Basic Education Certificate Examination (BECE) result which shows that six years, less than 30% of students in Taraba State who sat for Basic Science at during BECE obtained credit grade (C) and above. Teacher's choice of strategy could be a determinant of students' low on high performance in Basic Science; as such teachers should choose strategies that can actively involve the students in their learning and also one that will make the students to learn from each other. However, the poor performance in basic science infers that there is dominant use of the conventional instructional strategy.

Conventional instructional strategies is a teacher-centered instruction where lectures, chalk-and-talk methods, and textbook-based learning dominate, with teachers guiding the pace and content of lessons (Alfianika et al., 2021). In this strategy, the teacher is the primary source of knowledge, delivering content through lectures or direct instruction while the students are typically passive recipients and expected to absorb and reproduce information. Susilo (2021) when describing conventional strategy posited that lessons are primarily delivered through verbal explanations and demonstrations with minimal student interaction during instruction. Consequently, students who learn through peer interaction are disadvantaged and cannot be able to achieve the learning gains they yearn for. Teachers may prefer conventional strategy due to familiarity. Given that the conventional strategy does not yield the learning gains expected, it is important to explore other strategies. In this study, jigsaw instructional strategy was considered.

The Jigsaw instructional strategy is a cooperative learning method where students work together to learn different segments of a topic, then come together to share their knowledge, creating a comprehensive understanding of the whole topic (Chukwu & Arokoyu, 2019). In this strategy, students are organized into heterogeneous home groups. Bolaji et al. (2015) asserted that the learning material is divided into segments, and each group member is assigned a specific segment to master. Students then form expert groups with peers from other home groups who have been assigned the same segment. In these expert groups, students discuss and deepen their understanding of their assigned topic. Finally, students return to their home groups to teach their peers about their expert topic, ensuring that all group members gain a comprehensive understanding of the entire subject matter (Oludipe, 2019). The jigsaw instructional strategy is believed to have several potential benefits. First, it encourages students to take responsibility for their own learning and that of their peers, fostering a sense of accountability and motivation. Second, by breaking down complex topics into smaller, more manageable parts, the jigsaw method can facilitate better understanding and retention of the subject matter. Third, the collaborative nature of the strategy promotes social interaction, communication skills, and teamwork, which are essential skills for personal and professional development. In contexts not entirely identical to this study, the effectiveness of jigsaw has been demonstrated by previous studies.

Okeke and Dikeocha (2024) found that students' achievement is significantly enhanced when they are taught using jigsaw instructional strategy over the conventional lecture method. Ndikumana et al. (2024) observed that student's scores in biotechnology significantly favoured students who learned using jigsaw instructional strategy over the traditional lecture method. Ezeaghasi and Obochi (2021) found that students' performance in the jigsaw group is significantly better than that of their counterparts in the conventional lecture method. In basic science and technology, a similar finding was reported by Ifegbo and Onwuagboke (2024) reported that students'

achievement when taught using jigsaw instructional strategy is significantly higher than that of students taught using whole class strategy. Jigsaw could be suitable to for students learning basic science at the upper basic level; especially, if it is presented as a relatively novel instructional strategy for them. Learning collaboratively is crucial in building and activating students' affective domains; not only the affective domain; their overall performances improve as well. Another important factor affecting students' performance in basic science is gender.

Okorie and Ezeh (2016) defined gender as a psychological term and a cultural construct developed to differentiate between the roles and behavioural attributes of males and females. Gender roles and expectations within the community could influence students' interest, performance and retention in basic science. Oladejo et al. (2021) observed that the circumstances of gender have strongly interacted with culture to produce role stereotypes that cut across social, economic, political, and educational development, especially in the areas of science and technology. Societal biases may impact the encouragement or discouragement of male and female students from pursuing or performing in certain fields.

Gender related findings on jigsaw have mostly favoured both male and female students. For instance, Damoeroem et al. (2021) found that there is no significant difference in the achievement of male and female students when they are taught with jigsaw strategy. Jack and Yawe (2023) found that there is no significant difference in the achievement of male and female students when they learn using jigsaw instructional strategy. Mohammed and Samuel (2022) and Stanley et al. (2024) both found that jigsaw improved students' achievement irrespective of whether they are male or female students. There are instances where strategies and gender interaction effects were explored in relation to students' performance. Nwanko and Okigbo (2021) in this regards observed that there is no significant interaction effect of strategies and gender on students' achievement. Azeez et al. (2020) reported that no significant interaction effect of strategies and gender on students' achievement is observed. However Okafor and Nwosu (2021) reported that there is a significant interaction effect of strategies and gender on students' achievement. Addressing gender-related factors is essential for promoting equal opportunities and enhancing overall learning outcomes of students. One of the ways this can be done is through research of this type. It is in the light of the ongoing that this study seeks to investigate effect of jigsaw instructional strategy on students' performance in basic science in Taraba state, Nigeria.

### **PURPOSE OF THE STUDY**

The study sought to:

1. Find out the performance of students taught basic science concepts using jigsaw instructional strategy and conventional instructional strategy
2. Determine the performance of male and female students taught basic science concepts using jigsaw instructional strategy.
3. Ascertain the interaction effect of gender and teaching strategies on students' performance in basic science.

### **RESEARCH QUESTIONS**

1. What is the mean performance score of students taught basic science concepts using jigsaw instructional strategy and conventional instructional strategy?
2. What is the mean performance score of male and female students taught basic science concepts using jigsaw instructional strategy?
3. What is the interaction effect of gender and teaching strategies on students' performance in basic science?

### **HYPOTHESES**

**H<sub>01</sub>:** There is no significant difference in the mean performance score of students taught basic science concepts using jigsaw instructional strategy and conventional instructional strategy.

**H<sub>02</sub>:** There is no significant difference in the mean performance score of male and female students taught basic science concepts using jigsaw instructional strategy.

**H<sub>03</sub>:** There is no significant interaction effect of gender and strategies on students' performance in basic science.

## **METHODOLOGY**

The study adopted a quasi-experimental research design of pre-test, post-test non-equivalent group. The study sought to establish the cause-and-effect relationship between jigsaw instructional strategy and students' performance using intact classes. The population of the study consisted of all the students in upper basic two in the 43 public co-educational primary schools in Jalingo Education Zone of Taraba State, Nigeria. Data from the State's Ministry of Education reveals that there are 6,288 students at this level. The sample size of the study was 209 students. 91 students were in the experimental group while 118 students were in the control group. From the 91 students in the experimental group, 30 were male students while 60 were female students. Purposive sampling was used to select a school in Jalingo LGA and Ardo-Kola LGA that make up Jalingo Education Zone. This was in order to avoid schools in proximity from being random selected and also another criteria for purposive sampling was availability of qualified basic science teachers as only schools with qualified basic science teachers were used. Simple random sampling was used to select an intact upper basic II class in each of the two schools and assigned into experimental and control groups. The students were taught environmental hazards for four (4) weeks which encompassed erosion, deforestation, ozone layer depletion and global warming for weeks 1, 2, 3 and 4 respectively. The study was delimited to upper basic two students in Jalingo Education Zone and was conducted in third term of the 2024/2025 academic session of secondary schools in the State.

The instrument for data collection was Basic Science Performance Test (BSPT). BSPT is a 40-item multiple choice objective instruments to measure students' performance. The items have options ranging from A-D with one correct answer and three distractors. BSPT was faced and content validated by three experts from the Faculty of Education, Taraba state University, Jalingo. Two of the experts were from the Department of Science Education and one from Measurement and Evaluation unit in the Department of Educational Foundations. The reliability index of 0.88 was obtained for BSPT using Kuder-Richardson 20. Research assistants were trained which were basic science teachers from the sampled school, administration of pre-test which accounted for the initial differences between the two groups and treatment began in the second week because the first week was for training of research assistants. The treatment lasted for four (4) weeks where students in the experimental group learned using the jigsaw instructional strategy and students in the control group learned through conventional instructional strategy. Four (4) lesson plans for each of the two groups for each of the four (4) weeks of treatment were provided. Upon completion of treatment BSPT was re-administered to the students to measure their performance in basic science. The descriptive statistics of mean and standard deviation were used to answer all the research questions; while all the null hypotheses were tested using the inferential statistics of Analysis of covariance (ANCOVA) at 0.05 level of significance.

## **RESULTS**

### **Research Question 1**

What is the mean performance score of students taught basic science concepts using jigsaw instructional strategy and conventional instructional strategy?

**Table 1: Mean and standard deviation of performance score of students taught basic science concepts using jigsaw and conventional instructional strategies**

Strategies		PreBSPT	PostBSPT	Mean gain
JIS	Mean	10.82	24.16	13.34
	N	91	91	
	Std. Deviation	3.16	2.66	
CIS	Mean	10.91	13.93	3.02
	N	118	118	
	Std. Deviation	3.31	4.72	
<b>Mean difference</b>		0.09	10.23	10.32

Table 1 above indicates that before treatment, students in the jigsaw instructional strategy, being the experimental group, had mean performance score of 10.82 with standard deviation of 3.16 while students in the control group exposed to conventional instructional strategy had a mean score of 10.91 with standard deviation of 3.31. This means that initially, students in the conventional instructional strategy performed slightly better than students in the jigsaw instructional strategy group with mean difference of 0.09. The standard deviation values at this stage depict that the scores of students in the conventional instructional strategy group were more dispersed compared to students in the jigsaw instructional strategy since it had a higher standard deviation. After the exercise, students in the jigsaw instructional strategy had mean performance score of 24.16 with standard deviation of 2.66 while students in the conventional instructional strategy group had mean performance score of 13.93 with standard deviation of 4.72. The standard deviation values at this stage depict that the performance of students in the conventional instructional strategy group were more dispersed compared to students in the jigsaw instructional strategy since it had a higher standard deviation. Students in the jigsaw instructional strategy showed better performance than their counterparts in conventional instructional strategy as they gained 13.34 to 3.02 obtained by students in the conventional instructional strategy group. The difference in mean gain is 10.23 in favour of jigsaw instructional strategy.

### Research Question 2

What is the mean performance score of male and female students taught basic science concepts using jigsaw instructional strategy?

**Table 2: Mean and standard deviation of performance score of male and female students taught basic science concepts using jigsaw instructional strategy**

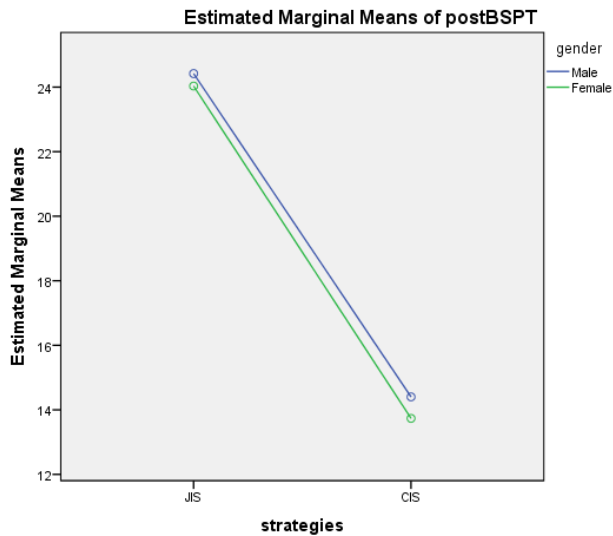
Gender JIS		preBSPT	PostBSPT	mean gain
Male	Mean	10.06	24.42	14.36
	N	31	31	
	Std. Deviation	3.32	3.09	
Female	Mean	11.22	24.03	12.81
	N	60	60	
	Std. Deviation	3.03	2.43	
<b>Mean difference</b>		1.16	0.39	1.55

Table 2 above indicates that at pre-test, male students in the jigsaw instructional strategy had mean performance score of 10.06 with standard deviation of 3.32 while their female counterparts had a mean rating of 11.22 with standard deviation of 3.03. This means that initially, the Female students' performance was higher than male students in the jigsaw instructional strategy with mean difference of 1.16. The standard deviation values at this stage depict that the scores of male students were more dispersed compared to the female students' scores since it had a higher standard deviation. After the exercise, male students in the jigsaw instructional strategy had performance mean score of 24.42 with standard deviation of 3.09 while female students in the same group had mean performance score of 24.03 with standard deviation of 2.43. Apparently, male students appeared to benefit slightly more in terms of performances than their female

counterparts as they gained 1.33 to 1.28 obtained by male students. The difference in mean gain is 1.02 in favour of the female students in the jigsaw instructional strategy.

**Research Question 3**

What is the interaction effect of gender and teaching strategies on students’ performance in basic science?



Covariates appearing in the model are evaluated at the following values: preBSPT = 10.87

Figure 1: Graph of interaction effect of strategies and gender on students' performance in basic science

The figure 1 above shows the interaction effect of the two strategies and gender on students' performance in basic science. From the graph, it could be deduced that the male and female lines near parallel but are not parallel and could intersect at the jigsaw instructional strategy part of the plots of the two strategies where the margin between the lines is smaller.. Since the two lines are not parallel and may intersect with each other, it means there is an interaction effect of strategies and gender on students' performance. This means that there is slight possibility of female students being favoured more in the jigsaw instructional strategy than their counterparts in the conventional instructional strategy group while the male students in the conventional instructional strategy group could be more favoured than female students in the jigsaw instructional strategy.

**Null Hypothesis 1**

**H<sub>01</sub>:** There is no significant difference in the mean performance score of students taught basic science concepts using jigsaw instructional strategy and conventional instructional strategy.

**Table 3: One way ANCOVA statistics of the performance score of students taught basic science concepts using jigsaw and conventional instructional strategies**

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	5380.096a	2	2690.048	170.638	.000	.624
Intercept	6244.121	1	6244.121	396.084	.000	.658
preBSPT	.474	1	.474	.030	.863	.000
<b>strategies</b>	<b>5377.476</b>	<b>1</b>	<b>5377.476</b>	<b>341.110</b>	<b>.000</b>	<b>.623</b>
Error	3247.512	206	15.765			
Total	79291.000	209				
Corrected Total	8627.608	208				

Table 3 above shows that  $F(1,206) = 341.110$  and  $p = 0.000$  which is less than the benchmark 0.05. This means that there is a significant difference in the mean performance of students exposed to jigsaw instructional strategy and conventional instructional strategy. Consequently, null hypothesis 5 is rejected. Table 4 indicated that students in the jigsaw instructional strategy gained more in performance. Subsequently, this test of hypothesis presented in table 11 above proves that the earlier established difference is statistically significant in favour of jigsaw instructional strategy. This means that jigsaw instructional strategy improved students' performance in basic science significantly more than conventional instructional strategy. In addition, the partial eta squared value of 0.623 shows that about 62.3% of the variation of the students' performance in basic science is accounted for by the effect of the treatment exercise.

### Null Hypothesis 2

**H<sub>02</sub>:** There is no significant difference in the mean performance score of male and female students taught basic science concepts using jigsaw instructional strategy.

**Table 4: ANCOVA result of performance score of male and female students taught basic science concepts using jigsaw instructional strategy**

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	3.565a	2	1.782	.248	.781	.006
Intercept	4220.315	1	4220.315	586.745	.000	.870
JpreBSPT	.519	1	.519	.072	.789	.001
<b>Jgender</b>	<b>2.539</b>	<b>1</b>	<b>2.539</b>	<b>.353</b>	<b>.554</b>	<b>.004</b>
Error	632.963	88	7.193			
Total	53775.000	91				
Corrected Total	636.527	90				

The table 4 above shows that  $F(1,88) = 0.353$  and  $p = 0.554 > 0.05$ . This means that the significance level is higher than the benchmark of 0.05. Consequently, the null hypothesis is accepted as this signifies that there is no significant difference in the mean performance of male and female students exposed to jigsaw instructional strategy. Table 5 showed the mean difference in performance of male and female students in the jigsaw instructional strategy where male students gained more than their male counterparts. However, the result of the test of hypothesis presented in table 12 above shows that the difference is not significant. This means that male and female students taught basic science through jigsaw instructional strategy will gain equally in terms of performance. The partial eta squared value to this regards is 0.004 meaning only 0.4% of the variation of students' performance in basic science in jigsaw instructional strategy group was due to gender differences.

### Null Hypothesis 3

**H<sub>03</sub>:** There is no significant interaction effect of gender and strategies on students' performance in basic science.

**Table 5: Two-way ANCOVA result of interaction effect of gender and strategies on students' performance in basic science.**

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	5393.558a	4	1348.389	85.055	.000	.625
Intercept	6168.084	1	6168.084	389.075	.000	.656
preBSPT	.000	1	.000	.000	.997	.000
Strategies	4610.035	1	4610.035	290.795	.000	.588

Gender	11.929	1	11.929	.752	.387	.004
<b>strategies</b>	<b>* .870</b>	<b>1</b>	<b>.870</b>	<b>.055</b>	<b>.815</b>	<b>.000</b>
<b>gender</b>						
Error	3234.050	204	15.853			
Total	79291.000	209				
Corrected Total	8627.608	208				

Table 5 above shows that interaction effect of strategies and gender,  $F(1,204) = 0.055$ ;  $p = 0.815 > 0.05$ . This means the result of test of significance is higher than the benchmark 0.05; consequently, the null hypothesis is accepted. This implies that there is no significant interaction effect of strategies (jigsaw instructional strategy and conventional instructional strategy) and gender on students' performance in basic science. Figure 6 showed that there is a possibility of intersection of the plots of gender and strategies. However, this test of hypothesis confirms that the intersection, otherwise called interaction is not significant. Essentially, this infer that the performance gain accompanying the use of either jigsaw instructional strategy and conventional instructional strategy does not depend on whether the student involved is a male or female. The partial eta squared value of 0.000 means that 0% of the students' performance gain in both groups was as a result of the interaction of the strategies and gender of students.

### DISCUSSION OF FINDINGS

The study found that students in the jigsaw group performed significantly better than students in the conventional group. Jigsaw instructional strategy improved students' academic performance in basic science because it requires each student to master and teach a portion of the content, reinforcing their understanding. It also facilitates collaboration and critical thinking, which deepen comprehension. In comparison, the conventional strategy often relies on passive listening, which must have led to superficial learning making the students to underperform in comparison with students in the jigsaw instructional strategy group. There is an added advantage accompanying jigsaw strategy as in the instructional process, students assume the role of teachers intermittently by explaining concepts to their peers. This active of doing improves students' performance as they know they need to understand better before explaining. The finding aligns with Okeke and Dikeocha (2024) who found that students' achievement is significantly enhanced when they are taught using jigsaw instructional strategy over the conventional lecture method. It also agrees with Ndikumana et al. (2024) who found that student's scores in biotechnology significantly favoured students who learned using jigsaw instructional strategy over the traditional lecture method. The finding corroborates Ezeaghasi and Obochi (2021) who found that students' performance in the jigsaw group is significantly better than that of their counterparts in the conventional lecture method. In basic science and technology, a similar finding was reported by Ifegbo and Onwuagboke (2024) who found that students' achievement when taught using jigsaw instructional strategy is significantly higher than that of students taught using whole class strategy.

Gender and performance related findings revealed that male and female students taught using jigsaw showed no significant difference in their performance. The collaborative structure minimizes gender-based dominance or bias, giving all students equal opportunities to contribute and succeed. It focuses on individual responsibility within a team, ensuring that each student, regardless of gender, engages meaningfully with the content. This balanced approach supports equitable learning outcomes. Similarly, it was observed that both male and female students appreciated the jigsaw instructional strategy implementation as it served as a paradigm shift from the conventional or traditional mode of instruction they have been used to. The novelty accompanying the strategy for the students helped to improve the students' performance irrespective of gender. This is consistent with the findings of Damoeroem et al. (2021) who found that there is no significant difference in the achievement of male and female students when they

are taught with jigsaw strategy. It also agrees with Jack and Yawe (2023) who found that there is no significant difference in the achievement of male and female students when they learn using jigsaw instructional strategy. In the same vein, the finding agrees with Mohammed and Samuel (2022) and Stanley et al. (2024) who found that jigsaw improved students' achievement irrespective of whether they are male or female students.

The study's findings revealed that there is no significant interaction effect of strategies and gender on students' performance. This further proves that jigsaw instructional strategy combines well with other strategies by improving students' performance and not depending on their gender. The finding aligns with Nwanko and Okigbo (2021) who found that there is no significant interaction effect of strategies and gender on students' achievement. It further agrees with Azeet et al. (2020) who found no significant interaction effect of strategies and gender on students' achievement. However, the finding is discordant with the findings of Okafor and Nwosu (2021) who found that there is no significant interaction effect of strategies and gender on students' achievement.

### CONCLUSION

Based on the findings of this study, the study concluded that jigsaw instructional strategy enhances students' performance in basic science significantly better than conventional strategy. Utilisation of the strategy infers that students' will show improved performance ability in basic science. The study also concluded that gender does not significantly influence students' performance when taught with jigsaw instructional strategy neither does it have a significant interaction effect with gender. The ultimate goal of improving students' learning outcomes irrespective of gender could be attained in basic science in Taraba State with the utilisation of jigsaw instructional strategy.

### RECOMMENDATION

1. Teacher of basic science in Taraba State should utilise jigsaw instructional strategy for classroom instructions to improve students' performance in the subject.
2. The concept of Environment Hazards should be taught with jigsaw instructional strategy.
3. Jigsaw instructional strategy should be used by teachers to eliminate gender disparity especially when there is evidence of gender differences in students' performance

### REFERENCES

- Alfianika, N., Syafii, W., & Supriusman, S. (2021). The influence of conventional teaching methods on students' achievement in physics. *Journal of Physics: Conference Series*, 1749(1), 1-10.
- Aniekwe, A. F. (2019). *Awareness and utilization of innovative teaching strategies in Oyo South Senatorial District*. [Unpublished Master's thesis] University of Ilorin, Nigeria.
- Azeez, A. A., Omananyi, E., Kwasi, O., Ndanusa, B., & Omachoko, L. (2020). Effect of jigsaw and peer-tutoring instructional strategies on senior secondary school students' academic achievement and interest in periodic table of elements in Ankpa local government area of Kogi state. *Unizik Journal of Educational Research and Policy Studies*, 13(1), 76-90.
- Bolaji, C., Kajuru, Y. K., & Timayi, J. M. (2015). Effects of Jigsaw IV cooperative learning strategy (J4CLS) on academic performance of secondary school students in geometry. *International Journal of Mathematics Trends and Technology*, 28(1), 12-18.

- Chukwu, J. C. & Arokoyu, A. A. (2019). Effects of jigsaw-puzzle instructional strategy on secondary school students' performance on growth as a concept in biology in Abia State. *Advances in Research*, 20(1), 1-6.
- Damoeroem, E. O. & Dakang, P. D. & Dampare, L. (2021). Effect of jigsaw instructional strategy on senior school physics students' achievement in Jos, Nigeria. *International Journal of Innovative Research & Development*, 10(3), 89-94.
- Etuk, K., Koko, E. Q. A., Amos, O. O., Gbolagade, O. R. & Olawale, I. M. (2019). Instructional materials and students' academic performance in physics: Some policy implications. *European Journal of Humanities and Social Sciences*, 2(1), 1-12.
- Ezeaghasi, N. E., & Obochi, U. M. (2021). Effect of jigsaw learning strategy on academic performance of senior secondary students in biology concepts at Soba Local Government Area, Kaduna State. *Journal of Science Technology and Education*, 9(4), 183-189.
- Ifegbo, P. C. & Onwuagboke, B. B. C. (2024). Effects of jigsaw instructional strategy on students' achievement in basic science technology (bst) in Owerri education zone. *Journal of Curriculum Enrichment*, 5(3), 1-9.
- Jack, G. U. & Yawe, J. G. (2023). Effect of cooperative learning with focus on jigsaw model on secondary school students' academic achievement in chemistry. *International Journal of Economics Education Research*, 6(1), 60-74.
- Mohammed, B. K. & Samuel, I. R. (2022). Effect of jigsaw ii learning strategy on students' achievement in cell and its environment in Niger State, Nigeria. *International Journal of Innovative Education Research*, 10(1), 69-76.
- Ndikumana, Y., Mugabo, L. R. & Nsabimana, A. (2024). Effect of jigsaw teaching method on students' performance in biotechnology, their perceptions of its benefits and constraints in its use. *African Journal of Educational Studies in Mathematics and Science*, 20(2), 239-259.
- Nwankwo, M. U. & Okigbo, E. C. (2021). Effect of jigsaw teaching strategy on academic achievement and retention of Anambra state secondary school students in chemistry. *Unizik Journal of Educational Research and Policy Studies*, 7, 375-386.
- Okafor, C. F. & Nwosu, C. E. (2021). Effect of jigsaw teaching strategy on senior secondary school students' achievement in mathematics in Onitsha education zone of Anambra state. *COOU Journal of Science Education and Allied Discipline*, 3(1), 19 – 27.
- Okeke, A. U. & Dikeocha, L. U. (2024). Effect of jigsaw teaching approach on students' academic achievement and retention in business education practicum in Colleges Of Education, South East, Nigeria. *NAU Journal of Technology & Vocational Education*, 9(2), 56-65.
- Okorie, E. U., & Ezeh, D. N. (2016). Influence of gender and location on students' achievement in chemical bonding. *Mediterranean Journal of Social Sciences*, 7(3), 309-318
- Oladejo, A. I., Nwabokub, N. C., Okebukola, P. A., & Ademola, I. A. (2021). Gender difference in students' performance in chemistry—can computer simulation bridge the gap? *Research in Science and Technological Education*, 41(2), 1-20.

- Oludipe, D. I. (2019). Gender difference in Nigerian upper basic students' academic achievement in basic science. *Journal of Education and Social Research*, 2(1), 15-21.
- Stanley, E., Dania, P. O. & Osakwe, E. O. (2024). Effect of jigsaw teaching strategies on social studies students' academic achievement in Delta State Secondary Schools. *Journal of Science Technology and Education*, 12(4), 227-238.
- Susilo, H. (2021). Revisiting the traditional approach: Is lecture still effective in today's classroom? *International Journal of Educational Research Review*, 6(2), 98–105.