

Effects of Jigsaw-Based Instructional Strategy (JBIS) and Demonstration Method on Students' Achievement and Retention in Biology

Chinweuba-Eze, V.O.

Department of Science Education, University of Nigeria Nsukka, Enugu State Nigeria

E-Mail: chinweubaezevictoria@gmail.com

Abstract

This paper sought to determine the efficacy of jigsaw-based instructional strategy and demonstration method on students' achievement and retention in biology. Three research questions were posed and three null hypotheses were formulated for the study. The research design for the study was 2x2 factorial design. The population of the study comprised of 4,840 SS2 Biology students in Ogidi education zone of Anambra State during 2020/21 academic session. The sample size of the study was 160 SS2 Biology students. BAT was calculated using estimate of temporal stability was done using Pearson product moment correlation coefficient (PPMCC) which gave a reliability index of 0.78. The data collected were analysed using mean and standard deviation to answer the research questions, while ANCOVA was used to test the null hypotheses at 0.05 level of significant. Findings unveiled that the use of jigsaw-based instructional approach was superior in enhancing achievement and retention of biology students than with demonstration method. Also, gender was not a significant factor in determining students' retention in biology. Based on the findings, recommendations were also made.

Keywords: Jigsaw-based Instruction, Demonstration, Achievement, Retention and Biology

Introduction

The practice or act of developing and introducing new things is most welcomed in different sectors of life. In educational sector, this act is mainly geared towards having an improved teaching and learning process. Komal (2021) asserted that teaching and learning aims at transmission of knowledge, imparting skills and formation of attitudes, values and behaviour. Thus, the use of diverse teaching methods in actualizing these aims remains important. Teaching method according to Garrett (2008), can be grouped into teacher-centred and student-centred. In teacher-centred method, the students are viewed as an empty vessel who passively receive knowledge from their teachers through lectures and direct instruction with an end goal of positive results from testing an assessment. This method uses different approaches such as direct instruction, flipped classrooms, kinesthetics learning, differentiated instruction and many more. However, in student-centred classroom, teaching and assessment is connected because students' learning is continuously measured during teacher instruction. Approaches use in students-centred classroom include; inquiry-based learning, expeditionary learning, personalized learning, game-based learning, choice boards, inquiry-based learning, project-based learning, jigsaw instructional strategy and many more (Andrew, 2020).

Based on the variable of interest in this paper, the researcher would focus more on jigsaw instructional strategy. The method of structuring

classroom activities that places students' success in the hands of one another is termed jigsaw instructional strategy. Since jigsaw instructional strategy brings about both individual accountability and achievement of the team goals it could be seen also as cooperative learning method (Nduji, Nwandikor, Keziah & Elejere, 2020). This type of learning strategy tries to reduce racial conflict among school children, promotes better learning, improve students' motivation and learning experience. Jigsaw instructional strategy is set up in such a way that classes are divided into groups, and assignments are broken down into parts that the group puts together to create the (jigsaw) puzzle (Lestik & Plous, 2012). This means that the teacher who wants to use jigsaw instructional strategy should adhere to the following steps as stipulated by Aronson (2010), thus;

- Divide students into 5 or 6 person's jigsaw group: The groups should be diverse in terms of gender, ethnicity, race, and ability.
- Appoint one student from each group as the leader: Initially, this person should be the most mature student in the group
- Divide the day's lesson into 5-6 segments
- Assign each student to learn one segment
- Give students time to read over their segment at least twice and become familiar with it

- Form temporary expert groups by having one student from each jigsaw group join other students assigned to the same segment
- Bring the students back to their jigsaw group
- Ask each student to present her or his segment to the group
- Float from group to group observing the process
- At the end of the session, give a quiz on the material

From the outlined jigsaw instructional steps, it could be said that this strategy may enhance cooperative learning by making each student responsible for teaching some of the material to the group. Thus, the researcher wants to determine the efficacies of this strategy (jigsaw instruction) and demonstration method on students' achievement and retention in biology. Demonstration involves a stepwise process which makes it a method.

The demonstration method as a variable under investigation in the present study is attributed to the teaching-learning process which is carried out systematically. This method is structured in such a way that ideas are normally communicated with the aid of visuals such as flip charts, posters, power point, etc (Smith, 2002). This implies, as you show how, you tell what you are doing. Demonstration often occurs when students have a hard time connecting theories to actual practice or when students are unable to understand applications of theories (Priyono, Yoyok & Dewie, 2018). To start the process of using demonstration method, one has to brainstorm on something (that you would like to know more about, of huge interest and something that challenges your ability); plan; outline (introduction, body and summary); plan your visuals, consider your appearance; organize your equipment and supplies; and practice your delivery (McKee, Vickie & Laura, 2007). This implies that in demonstration method, the teacher is expected to provide students with experiences of real events, phenomena, and processes, helping them learn and improve raise students' achievement, interest, and motivation. However, previous researchers who have experimented on the use of demonstration method in science education revealed that it improves students' achievement in physics (Okotubu, 2020; Ugwuanyi, Nwankwo, & Ugwuoke, 2016); it is an attention inducer and a powerful motivator in mathematics lesson delivery (Ochogba, Ogide & Ogide, 2019); it enhances retention in biology (Ameh & Dantan, 2017); it improves chemistry students' retention (Njoku & Attah, 2018). On the other hand, none of the

reviewed literature investigated the use of jigsaw instructional strategy and demonstration method to enhance students' achievement and retention in biology.

Biology is derived from Greek word 'bios' meaning life and 'logos' meaning study. Thus, is defined as the science of life and living organisms. Biology as a science of life is offered in all senior secondary schools in Nigeria and attracts the greatest patronage of both science-oriented and art-based students. Thus, biology has a very high enrolment of students in external examination more than physics and chemistry (Buba, Banus & Adamu, 2020). Despite this high number of enrolment in senior secondary school biology, students' poor achievement in this subject has been a thing of concern to parents, policy makers and examination bodies (Ihekwoaba, 2020; Agogo & Naakaa, 2014). Scholars (Attah, & Ita, 2017; Nnamani & Oyibe, 2016; Odagboyi, 2015) have argued that the cause of students' poor achievement in a subject could be attributed to their gender while to some scholars (Nduji & Madu, 2020) gender is not a significant factor in determining students' achievement. Hence, the inclusion of gender in the paper as a moderating variable. The researcher also sought to determine if gender could influence students' retention specifically in biology. Based on this background the need for the study.

Research Questions

The following research questions guided the study;

1. What are the mean achievement scores of students' taught biology using jigsaw-based instructional strategy and those taught using demonstration method?
2. What are the mean retention scores of students' taught biology using jigsaw-based instructional strategy and those taught using demonstration method?
3. What is the influence of gender on students mean retention score in biology?

Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance;

1. Mean achievement scores of students' taught biology using jigsaw-based instructional strategy and those taught using demonstration methods will not be statistically significant
2. Mean retention scores of students' taught biology using jigsaw-based instructional strategy and those taught using

demonstration methods will not be statistically significant

3. There is no significant difference in the mean retention scores of male and female students in biology

Methods

The research design for the study was $2 \times 2 \times 2$ factorial design. The population of the study comprised of 4,840 SS2 Biology students (that is; 2045 males and 2,795 females) in Ogidi education zone of Anambra State during 2020/21 academic session. A sample size of 160 SS2 Biology students from two schools was used for the study. Simple random sampling technique specifically with replacement was used to determine the sample size. Co-educational schools were used to take care of gender variable in the study. The researcher randomly assigned 2 schools to the JBIS group and the other 2 schools to the demonstration method group and in each school an intact class was used. This implies that, four intact classes were used in the study. Each intact class contains 40 students making it a total of 160 students which formed the sample size. Biology Achievement Test (BAT) was used for data collection. The BAT was compiled by the researcher and it is made up of 20 multiple choice questions with a, b, c, d alternatives (options). The BAT was used to determine SS2 students' achievement both before and after the instructional treatment (pre-test and post-test). The 20 questions were selected by the researcher based on SS2 Biology content (i.e. micro-organism, food hygiene and global warming) that can be effectively taught using Jigsaw-based instructional strategy and demonstration method. Test blue print or table of specification was used to ensure content coverage. BAT was validated by three experts all from Science Education Department, University of Nigeria, Nsukka. Test retest was done using twenty (20) Biology students from school outside the sample of the study which have similarities that are necessary for the study. An estimate of temporal stability was

done using Pearson product moment correlation coefficient (PPMCC) which gave a reliability index of 0.78. The choice of this reliability estimate was because BAT was used to measure a trait (ie. retention) on two different occasions.

Experimental Procedure

Two lesson plans were produced for the JBIS group while for demonstration method, two lesson plans were also developed on the same topic. The experiment lasted for six (6) weeks. The sampled students' teachers were used as research assistants. The reason for the choice of student teachers as research assistants was to mitigate faking of response by the students. This is because new teacher other than their own teacher may bring the students thought of been used for experiment. The research assistants were properly trained using JBIS lesson plans and demonstration method lesson plans. After three weeks of examining JBIS group, the demonstration method group taught where taught the same learning unit for three weeks using demonstration method lesson Plan. Post-test was administered to both the experimental and control groups of the intact classes. The scores of the JBIS group in both pre-test and post-test was recorded and compared with that of demonstration method group scores. The data collected were analysed using mean and standard deviation to answer the research questions, while analysis of covariate was used to test the null hypotheses at 0.05 level of significant.

Results

Research Question One: What are the mean achievement scores of students' taught biology using jigsaw-based instructional strategy and those taught using demonstration method?

Table 1: Pretest and Post-test Mean Achievement Scores of Students' Taught Biology Using Jigsaw-Based Instructional Strategy and those Taught Using Demonstration Method

Methods	N	Pre-test		Post-test		Mean Gain
		\bar{X}	SD	\bar{X}	SD	
Jigsaw Instructional Strategy	80	65.12	18.10	77.06	14.85	11.94
Demonstration Method	80	48.63	16.45	68.50	14.87	19.87

NB: \bar{X} = mean; SD = Standard Deviation

Result in Table 1 shows that students who were taught Biology using jigsaw-based instructional

strategy had mean achievement score of ($M = 65.12$, $SD = 18.10$) at the pretest and mean achievement

score of ($M = 77.06$, $SD = 14.85$) at the posttest, while those who were taught Biology using demonstration method had mean achievement score of ($M = 48.63$, $SD = 16.45$) at pretest and mean achievement score of ($M = 68.5$, $SD = 14.87$) at posttest. Mean difference of 11.94 and 19.87 for those taught biology using jigsaw-based instructional strategy and those taught using demonstration methods respectively imply that students taught biology using jigsaw-based instructional strategy achieved more than those taught using demonstration method. This implies that teaching biology using jigsaw-based

instructional strategy enhanced students' achievement more than demonstration method.

Hypothesis One: Mean achievement scores of students' taught biology using jigsaw-based instructional strategy and those taught using demonstration methods will not be statistically significant.

Table 2: Analysis of Covariance (ANCOVA) of the difference in the mean achievement scores of students' taught Biology using jigsaw-based instructional strategy and those taught using demonstration methods

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	(η^2_p)	Decision
Corrected Model	17880.484 ^a	2	8940.242	70.333	.000	.473	
Intercept	22310.064	1	22310.064	175.513	.000	.528	
PretestAch	14947.827	1	14947.827	117.594	.000	.428	
Methods	3655.995	1	3655.995	145.983	0.00	.520	S
Error	19956.860	157	127.114				
Total	885375.000	160					
Corrected Total	37837.344	159					

a. R Squared = .473 (Adjusted R Squared = .466)

NB: S = Significant, NS = Not Significant and η^2_p = partial eta squared

The result on Table 2 shows ANCOVA analysis of the significant difference in the mean achievement scores of students taught biology using jigsaw-based instructional strategy and those taught using demonstration methods. The result shows that an f-ratio of ($F(1, 159) = 145.983$, $p < .05$, $\eta^2_p = .520$) was obtained. Since the associated probability value of 0.00 is less than 0.05 set as level of significance, the null hypothesis was rejected. Thus, it was concluded that there is a significant difference in the mean achievement scores of students' taught biology using jigsaw-based instructional strategy and those taught using demonstration methods. This indicates that teaching biology using jigsaw-based instructional

strategy proved to be more effective in enhancing students' academic achievement. The result further showed the effect size of ($\eta^2_p = .520$), which indicates that 52.0 percent variance in students' achievement in biology can be attributed to the effect of instructional approaches.

Research Question Two: What are the mean retention scores of students' taught biology using jigsaw-based instructional strategy and those taught using demonstration method?

Table 3: Mean retention scores and standard deviation of students taught Biology using jigsaw-based instructional strategy and those taught using demonstration method

Methods	N	Pretest		Post-test		Mean Gain
		Mean	SD	Mean	SD	
Jigsaw-Based Instructional Strategy	80	66.56	19.202	85.38	9.929	18.82
Demonstration Method	80	63.00	16.906	72.19	16.125	9.19

NB: \bar{x} = mean; SD = Standard Deviation

Result in Table 3 shows that students who were taught Biology using jigsaw-based instructional strategy had mean retention score of ($M = 85.38$, $SD = 9.929$) at the posttest and mean retention score of ($M = 66.56$, $SD = 19.202$) at the pretest, while those who were taught Biology using demonstration

method had mean retention score of ($M = 72.19$, $SD = 16.125$) at posttest and mean retention score of ($M = 63.00$, $SD = 16.906$) at the pretest. Mean difference of 18.82 and 9.19 for those taught biology using jigsaw-based instructional strategy and those taught using demonstration method respectively

imply that students taught biology using jigsaw-based instructional strategy retain more than those taught using demonstration method. Thus, teaching biology using jigsaw-based instructional strategy enhanced students' retention more than demonstration method.

Hypothesis Two: Mean retention scores of students' taught biology using jigsaw-based instructional

strategy and those taught using demonstration method will not be statistically significant

Table 4: Analysis of Covariance (ANCOVA) of the difference in the mean retention scores of students' taught Biology using jigsaw-based instructional strategy and those taught using demonstration method

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	η^2_p	Decision
Corrected Model	13976.785 ^a	2	6988.392	51.485	.000	.396	
Intercept	34497.164	1	34497.164	254.149	.000	.618	
PretestRet	7020.378	1	7020.378	51.721	.000	.248	
Method	5585.645	1	5585.645	41.151	.000	.208	S
Error	21310.559	157	135.736				
Total	1028325.000	160					
Corrected Total	35287.344	159					

a. R Squared = .396 (Adjusted R Squared = .388)

NB: S = Significant, NS = Not Significant and η^2_p = partial eta squared

The result on Table 4 shows ANCOVA analysis of the significant difference in the mean retention scores of students taught biology using jigsaw-based instructional strategy and those taught using demonstration method. The result shows that an f-ratio of ($F(1, 159) = 41.151, p < .05, \eta^2_p = .208$) was obtained. Since the associated probability value of 0.00 is less than 0.05 set as level of significance, the null hypothesis was rejected. Thus, inference drawn is that there is a significant difference in the mean achievement scores of students' taught biology using jigsaw-based instructional strategy and those taught

using demonstration method. This indicates that teaching biology using jigsaw-based instructional strategy proved to be more effective in enhancing students' retention. The result further showed the effect size of ($\eta^2_p = .208$), which indicates that 20.8 percent variance in students' retention in biology can be explained by the instructional approaches.

Research Question Three: What is the influence of gender on students' mean retention score in biology?

Table 5: Mean and standard deviation of male and female students' retention in Biology

Gender	N	Pretest		Posttest		Mean Gain
		Mean	SD	Mean	SD	
Male	72	61.88	18.810	78.33	16.294	16.45
Female	88	67.16	17.284	79.15	13.734	11.99

NB: \bar{x} = mean; SD = Standard Deviation

Result in Table 5 shows that male students had mean retention score of ($M = 61.88, SD = 18.810$) at the pretest and mean retention score of ($M = 78.33, SD = 16.294$) at the posttest, while female students had mean retention score of ($M = 67.16, SD = 17.284$) at pretest and mean retention score of ($M = 79.15, SD = 13.734$) at the posttest. Mean difference of 16.45 and 11.99 for both male and female students respectively on their retention scores in biology imply that male

students retain more in biology than their female counterparts.

Hypothesis Three: There is no significant difference in the mean retention scores of male and female students in biology

Table 6: Analysis of covariance (ANCOVA) of influence of gender on students' retention in Biology

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	η^2_p	Decision
Corrected Model	13330.444 ^a	2	6665.222	26.910	.000	.255	
Intercept	1809.387	1	1809.387	7.305	.008	.044	
Post-test Retention	12224.748	1	12224.748	49.356	.000	.239	
Gender	913.442	1	913.442	3.688	.057	.023	NS

Error	38886.900	157	247.687
Total	723675.000	160	
Corrected Total	52217.344	159	

a. R Squared = .255 (Adjusted R Squared = .246)

NB: S = Significant, NS = Not Significant and η^2_p = partial eta squared

The result on Table 4 shows ANCOVA analysis of the significant influence in the mean retention of male and female students' retention in biology. The result indicates that gender is not a significant factor on students' retention in biology with respect to jigsaw-based instructional strategy and demonstration method ($F = 3.688$, $p < 0.05$, $\eta^2_p = .023$). Thus, the null hypothesis of no significant difference in the mean retention scores of male and female students' in biology was accepted since the probability value of 0.057 is greater than 0.05 level of significance. The result further showed the effect size of ($\eta^2_p = .023$), which indicates that 2.3 percent variance in students' retention in biology can be explained by their gender.

Discussion

The result of this study revealed that students taught biology using jigsaw-based instructional strategy had more achievement than those taught using demonstration method. In other words, there is a significant difference in the mean achievement scores of students' taught biology using jigsaw-based instructional strategy and those taught using demonstration method. The result of this finding may not be far from the fact that students taught biology using jigsaw-based instructional strategy had in-depth exposure of biology content with the breaking down of jigsaw puzzle piece into home groups as treated in the study. This study is in agreement with the study of Nduji, Nwandikor, Keziah and Elejere (2020) whose report revealed that use of jigsaw-based cooperative learning strategy was more superior in enhancing achievement of physics students than lecture method. Similarly, Ojekwu and Ogunleye (2020), Chukwu and Arakoyu (2019), Bello (2016), Juweto (2015) in their separate studies unveiled that students taught with the jigsaw strategy achieved greater improvement in their mean scores than those taught with the conventional lecture method. However, the finding of this study is in disagreement with those of Ibrahim, Bashir, Buba and Thlama (2020), Ugwuanyi, Nwankwo & Ugwuoke (2016), Ekeyi (2013) whose results revealed that demonstration method had significant effect on students' achievement than those taught with the conventional lecture method. Joe (2019) also showed that there was a significant difference in the

academic performance of students who were taught with demonstration method and those who taught with guided discovery methods in Biology with students exposed to demonstration method achieving better than those exposed to guided discovery. This study is not in consonance with that of Joe (2019).

The report from the finding of this study also showcased that teaching biology using jigsaw-based instructional strategy enhances students' retention more. This could be as a result jigsaw-based instructional strategy been a student-centered learning strategy than demonstration method which is more teacher-centered. Additional analysis showed that there is a significant difference in the mean achievement scores of students' taught biology using jigsaw-based instructional strategy and those taught using demonstration method. The finding of this study is in alignment with that of Ihejiamaizu, Neji and Agiande (2020), Abdulwahab, Onyelekan and Olorundare (2016), Tran (2016) whose findings revealed that there is a significant effect of cooperative learning strategy and students' retention in biology. The finding of this study is also not in consonance with the findings of Okotubu (2020) and Eze, Ezenwafor and Obidile (2016) whose respective reports unveiled that students' who were taught using demonstration teaching method were able to retain the concepts than those students taught using conventional teaching method. This could be as a result of activities and experiences involved in demonstration teaching method which made the students develop their knowledge meaning and retain the concept taught. The result of this study also revealed that male students retain more in biology than their female counterparts. Further analysis showed that there was no significant difference in the mean retention scores of male and female students' in biology. This finding is in-alignment with that of Njoku and Attah (2018) who reported that gender was not a significant factor in the students' retention of concept of writing and balancing of equations. Also, Al-Hela (2010), Ameh and Dantanici (2017), and Hamadne (2017) in their different studies revealed that demonstration does not discriminate against gender. Thus, this is in-line with this finding of this study.

Conclusion

In a nutshell, the findings of the present study showed that the use of jigsaw-based instructional approach was superior in enhancing achievement

and retention of biology students than with the lecture method. Thus, students taught biology using jigsaw-based instructional strategy achieved and retained better than their counterparts. Also, gender was not a significant factor in determining students' retention in biology.

Recommendation

The following recommendations have been made based on the findings from this study:

1. The ministry of education should collaborate with state government and school management to ensure that senior secondary teachers are adequately trained on the effective use of jigsaw-based cooperative learning strategy.
2. In the view of the fact that jigsaw cooperative learning strategy improves students' retention, it is recommended that the curriculum planners would revisit the biology curriculum in order to include the use of jigsaw-based cooperative learning strategy.

References

- Abdulwahab, N., Onyelekan, O. & Olorundare, A. (2016). Effect of cooperative instructional strategy on senior school students' achievement in Electrochemistry. *Eurasian Journal of Physics and Chemistry Education*, 8(2), 37-48.
- Agogo, P.O. & Naakaa, D.A. (2014). Effects of constructivist instructional strategy on students' interest in senior secondary genetics in Gwer Local Government Area, Bene. *Global Journal of Environmental Sciences and Technology*, 1(2), 15-19.
- Al-Hela, M.M. (2010). The effect of cooperative learning on the experts' groups in the immediate and delayed achievement for the students of teaching design in the faculties of Educational Sciences. *Al-Manara Journal*, 13(4), 167-198.
- Ameh, P.O. & Dantan, Y.S. (2017). Effects of lecture and demonstration methods on academic achievement of students in chemistry in Nasarawa Local Government Area of Kano state. *International Journal of Modern Social Science*, 1(1), 29-37.
- Andrew, C.M. (2020). Student-centred learning strategies.
- <https://www.teachhub.com/teaching-strategies/2020/07/student-centered-learning-strategies/>
- Aronson, E. (2010). Jigsaw classroom. Retrieved 2nd July, 2021, from <https://www.jigsaw.org/>
- Attah, R.F. & Ita, P.M. (2017). Gender as predictor of academic achievement in English among senior secondary school two students in Calabar metropolis, Cross River state. *Global Journal of Educational Research*, 16, 149-153
- Bello, F.O. (2016). Effect of jigsaw cooperative learning on biology students' performance and interest level in photosynthesis in secondary schools in Owerri Metropolis, Imo State. *International Journal of Research in Education*, 4(2), 27-41.
- Buba, A.M., Banus, A.A. & Adamu, M. (2020). Gender differences in effectiveness of constructivist method of teaching Biology on academic performance of senior secondary school students in Maduguri metropolis, Borno state, Nigeria. *African Journal of Science Technology and Mathematics Education*, 5(1), 41-47.
- Chukwu, J. and Arakoyu, 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.
- Ekeyi, D.N. (2013). Effect of demonstration method of teaching on students' achievement in Agricultural Science. *World Journal of Education*, 3(6), <https://doi.org/10.5430/wje.v3n6p1>
- Eze, T.I., Ezenwafor, J.I. & Obidile, J.I. (2016). Effect of gender on students' academic performance and retention in Financial Accounting in Technical Colleges. *British Journal of Education, Society and Behavioural Science*, 18(4), 1-9.
- Garrett, T. (2008). Student-centred and teacher-centred classroom management: a case study of three elementary teachers. *Journal of Classroom Interaction*, 43(1), 34 – 47.
- Hamadneh, Q.M.S. (2017). The effect of using jigsaw strategy in teaching science on the acquisition of scientific concepts among the fourth graders of Bani Kinana directorate of

- education. *Journal of Education and Practice*, 8(5), 127-134.
- Ibrahim, I., Bashir, D. & Buba, M.A., Thlama, I.M. (2020). Effect of demonstration and lecture methods on academic performance of senior secondary school students' in Biology, Maiduguri metropolis, Borno state, Nigeria.
- Ihejiamaizu, C.C., Neji, H.A., Agiande, I.U. (2020). Effect of cooperative learning strategy on senior secondary school students' retention in Biology in Cross River State, Nigeria. *European Journal of Scientific Research*, 156(2)138 – 144.
- Ihekwoaba, C.C. (2020). Improving students' achievement and interest in Biology: The use of peer tutoring. (An Unpublished M.Ed Project), University of Nigeria Nsukka, Enugu state, Nigeria.
- Joe, P. (2019). Effect of demonstration method and guided discovery method on the academic performance of students in Biology in senior secondary schools. Retrieved 21st July, 2021 from <https://iproject.com.ng/index.php/education/>
- Juweto, G. A. (2015). Effects of jigsaw co-operative teaching/learning strategy and school location on students' achievement and attitude towards Biology in secondary school in Delta State. *International Journal of Education and Research*, 3(8), 31-40.
- Komal, U. (2021). Study notes on basic processes of teaching and learning. Retrieved 2nd June, 2021, from <https://gradeup.co/teaching-learning-process-i>
- Lestik, M., & Plous, S. (2012). Jigsaw classroom. Retrieved from [https://en.wikipedia.org/wiki/Jigsaw_\(teaching_technique\)#cite_note-5](https://en.wikipedia.org/wiki/Jigsaw_(teaching_technique)#cite_note-5)
- McKee, E., Vickie, M.W. & Laura, E.R. (2007). Effects of demonstration laboratory on student learning. *Journal of Science Education and Technology*, 16(5), 395-400.
- Nduji, C. C. & Madu, B.C. (2020). Influence of gender and location on students' conceptions of heat energy in senior secondary school Physics. *British Journal of Education*, 8(6), 1-17.
- Nduji, C.C., Nwandikor, C. Keziah, B.C. & Elejere, U.C. (2020). Effect of jigsaw-based cooperative learning strategy (JBCLS) on senior secondary school students 'interest and achievement in Physics. *International Journal of Studies in Education*, 16(1), 164-174.
- Njoku, Z.C. & Attah, F.O. (2018). Effect of demonstration method and cooperative learning technique on students' retention in the concepts of writing and balancing of chemical equations. *African Journal of Science, Technology and Mathematics Education*, 4(1), 187-195.
- Nnamani, S.C. & Oyibe, O.A. (2016). Gender and academic achievement of secondary school students in Social Studies in Abakaliki urban of Ebonyi state. *British Journal of Education*, 4(8), 72-83.
- Ochogba, C.O, Ogide, C.J & Ogide, C.G (2019). Effect of demonstration method on students' academic performance in basic technology in secondary schools in Ogba/Egbema/Ndoni Local Government Area, Rivers State, Nigeria. *International Journal of Innovative Scientific & Engineering Technologies Research*, 7(2), 28-32.
- Odagboyi, I.A. (2015). The effect of gender on the achievement of students in Biology using the jigsaw method. *Journal of Education and Practice*, 6(17), 176-179.
- Ojekwu, I. N. & Ogunleye, B. O. (2020). Effects of jigsaw learning strategy on science students' performance and interest in Biology in selected schools in Rivers State, Nigeria. *Sapientia Foundation Journal of Education, Sciences and Gender Studies*, 2(3), 325-334.
- Okotubu, J.O. (2020). Effect of demonstration teaching method on students' academic achievement and retention in Auto Mechanics Trade in Technical Colleges in Delta State. *International Journal of Education and Evaluation*, 6(5), 6-13
- Priyono, U., Yoyok, S. & Dewie, T. (2018). Influence of demonstration method, cooperative learning method and motivation against student results. *Interciencia Journal*, 48(2), 137-150.



- Smith, J. (2002). Learning style fashion Fad or lever for change? An implication of learning style theory to inclusive curriculum delivery innovations. *Education and teaching International*, 39(1), 63-70.
- Tran, V.D. (2016). The effects of jigsaw learning on students' knowledge retention in Vietnamese higher education. *International Journal of Higher Education* 5(2). <https://doi.org/10.5430/ijhe.v5n2p236>
- Ugwuanyi, C.S., Nwankwo, C. & Ugwuoke, E. (2016). Assessment of the efficacies of powerpoint presentation and demonstration methods on the interest and achievement of students in Physics. *Science Teachers Association of Nigeria 57th Annual Conference Proceedings*, 487-493.
- Voyles, M.J. (2011). Student academic success as related to student age and gender. Retrieved from <https://scholar.utc.edu/cgi/viewcontent>