International Journal of Innovative Social & Science Education Research 12(2):53-63, April-June, 2024

© SEAHI PUBLICATIONS, 2024 www.seahipublications.org ISSN: 2360-8978

Effects Of Jigsaw II Learning Strategy On Senior Secondary II Students' Attitudes Towards Learning Heat Energy Measurement In Sokoto State, Nigeria

[1]Abdullahi Abubakar; [2]Sani Idris & [3]Ahmad Rufa'I Abdullahi

[1&3]Department of Physics, Federal College of Education, Gidan Madi, Sokoto State Nigeria.
[2]Department of Physics, Aminu Saleh College of Education, Azare, Bauchi State Nigeria.

[1]aabawa18@gmail.com, +2348032609106
[2]ibntaymiyyah.sn@gmail.com, +2348035686728
[3]ahmadrufaig111@gmail.com, +2348061663329

ABSTRACT
This study is aimed at investigating the effects of jigsaw II learning strategy on senior secondary II students' attitudes towards learning Heat energy measurement in Sokoto State, Nigeria. Three research questions were answered and Three hypotheses were formulated and tested at 0.05 level of significance in the study. The study adopted quasi-experimental research design, specifically, the pretest-posttest non-equivalent control group design in which intact classes were assigned to the experimental and control groups. The population of the study comprised of the entire SS II students who are offering Physics in all Secondary School in the three Educational zones of Sokoto State, from which 210 SS II students from intact classes of two schools from the four educational zones in the state were sampled using purposive sampling technique. Four research assistants (two from each of the sampled schools) were employed to help the researchers in administering the treatments to both groups. A pre-test was conducted a week before commencement of the treatment which lasted for seven weeks. After the treatment a posttest was administered using the instruments. The instrument used was Students' Attitudes towards Physics Questionnaire (SATPQ). The instrument was validated by experts. Descriptive statistics (mean and standard deviation) were used to answer questions while inferential statistics (t-test and ANCOVA) were used to test the hypotheses. Data analysis was done using the Statistical Package for Social Science (SPSS) Version 25 and 0.05 level of significance was adopted for testing the hypotheses. The reliability of the SATPQ was found to be 0.76 using Cronbach's coefficient alpha method on the Statistical package for Social Sciences (SPSS) Software Version. The findings from the study revealed that Jigsaw II learning strategy had a significant effect on students' attitudes towards learning physics; that is, after students were exposed to treatment using jigsaw cooperative learning strategy they have developed better attitude toward Physics. It is also revealed that there is significant difference between the post-test mean attitude scores of the students taught physics using jigsaw II learning strategy and their counterparts using conventional lecture method; that is Jigsaw II learning strategy enhanced students' attitude towards learning Physics more than conventional lecture method that is popular and commonly used by Physics teachers. The findings also showed that the male students attitudes towards physics improved slightly higher than their female counterparts when taught physics using jigsaw cooperative learning strategy, however, it revealed that there is no significant interaction effect between treatment and gender on student's attitude toward Physics. Based on the findings of the study, some recommendations were made as, seminars and workshops should be organize by professional bodies like Science Teachers Association of Nigeria (STAN) on jigsaw cooperative learning strategy to stimulate and popularize their use in classrooms and Physics teachers should be encouraged to use jigsaw II learning strategy as method of instruction in order to improve their teaching, students' attitude towards learning physics.

Keywords: Jigsaw II, cooperative learning, attitude, strategy

INTRODUCTION

The Nigerian education system recognizes our stages of formal education, namely: pre-primary (early childhood) education, which IS three years; primary education which is six years; secondary education, which is also six years and tertiary education which ranges between three years in Colleges of Education and six years in Universities. Secondary education is further sub-divided into three years each of junior secondary school (JSS) and senior secondary school (SSS). The six years of primary school education and the three years of JSS education are classified as basic education. The Federal Republic of Nigeria (FRN) 2004) outlined the core science subjects in the SSS curriculum as Biology, Chemistry and Physics. These three subjects can be categorized into biological sciences and physical sciences. Biology falls into the biological sciences and it deals with animals matter. While Physics and Chemistry are physical sciences which deal with the properties and behaviour of inanimate matter, it is somewhat difficult to vividly differentiate between Physics and Chemistry. However, a broad perspective of the difference between the two subjects is that Physics deals mainly with inanimate matter in relation to energy, while Chemistry concerns itself with the action of one kind of inanimate mater (substance) on another. The knowledge of these core science subjects, therefore, provide foundation to science students at the SSS level for further studies in science and science-related courses at the tertiary level.

Physics has been defined by Nelkon (2013) as a science subject which studies non-living matter and its behaviour in relation to energy. This implies that Physics provides the relationship between inanimate matter and energy, which forms a basis of technologically-enhanced human livelihood. Nigerian Educational Research and Development Council (NERDC) 2008) opined that Physics as a subject is critical for effective living in the contemporary science and technology world. This is an indication that the study of Physics at the secondary school level, which is where the basics of Physics are taught, should not be underestimated. Physics is all around man through its principles, laws and theories. For instance, it is in the electric light that is switched on, the car that is driven, the wristwatch that is strapped on, the cell phone, radio and television set. It is in the equipment used for diagnosing diseases in patients. It is also in the football that is being played or watched. It then means that a decline in the comprehension of Physics concepts which underpin the understanding of other fields will result to a gradual decline in the understanding of such fields as agriculture, engineering, medicine and telecommunication. To enhance the study of Physics in schools, the contemporary world is shifting focus from teacher-centred instructional strategies to student-centred strategies. This is because teacher- centred methods of teaching seem not to promote critical thinking skills in students and consequently problem solving skills, which in turn lead o Performance.

Many student-centred methods of teaching abound such as cooperative learning, collaborative learning, discovery/inquiry-based learning, problem-based learning. concept mapping, mind mapping, cognitive analysis, games and simulation which are all considered as active learning. Student-centred methods of teaching have numerous advantages for the student in the teaching-learning process. One major advantage is that such methods of teaching can become more interesting for students than the passive teacher-centred methods. In the opinion of Karamustafaoglu (2009), students are motivated and their attitudes uplifted when they make decisions in their own learning and when their mental ability is challenged. Furthermore, Karamustafaoglu, Tran and Lewis (2012) noted that student-centred methods of teaching develop students' learning skills, communication and improve performance. This implies that student-centered strategies offer opportunities to students for practically learning scientific concepts.

To achieve the aforementioned objectives, cooperative learning strategies need to be employed by physics teachers. Cooperative learning is a strategy of teaching that has gained a lot of research interest in recent years. Due to its relevance, it is regarded as one of the greatest innovations in the educational system. Cooperative learning strategies are instructional techniques in which students work in small groups to help one another learn academic material. The use of these strategies has been increasing rapidly in use at all instructional levels, from elementary school to college, and in every school subject (Abdullah &Filiz, 2017). In this study, jigsaw cooperative learning strategy will be adopted.

The jigsaw strategy, developed by Elliot Aronson, is a group-work method for learning and participation in group learning activities. It is a cooperative learning strategy that enables each student of a group to specialize in one aspect of a learning unit to resolve a task or class project. Aronson and his post-graduate students observed classes with a typical competitive environment had effect of enmity among people, and thus jigsaw method emerged as a result of the need to transform competitive environment into collaboration. Aronson emphasizes that the jigsaw method encourages students to listen, cooperate and exchange ideas. Jigsaw a technique of collaborative learning method, is used to increase students' education and social performances. Today, jigsaw model has an increasing number of applications in academic level (Aronson & Patoe, 1996).

The jigsaw cooperative learning strategy enhances cooperative learning by making each student responsible for teaching some of the material to the group. In this strategy, students are members of two different groups, the 'home group' and the 'expert group'. Initially, students meet in their home groups and each member of the group is assigned a portion of the material to learn as an 'expert'. The home groups then break apart, like pieces of a jigsaw puzzle, and students move to expert groups, which consist of members from the home groups who have been assigned the same portion of the material. While in the expert groups, the students discuss their particular material to ensure that they understand it. Students then return to their home groups, where they teach their portion to the rest of their group (Colossi & Zales, 2008).

Negative attitudes of students themselves have been suggested as a contributory factor to misconceptions and poor Performance in physics at tertiary level (Olusola, &Rotimi,2012). Physics is considered as the most problematic area within the realm of science, and it traditionally attracts fewer students than chemistry and biology. Physics is perceived as a difficult course for student from secondary school to university and also for adults in graduate education. It is well known that both high school and college students find physics difficult (Adesoji, 2008).

Based on the issues discussed, this study is set to investigate the effects of jigsaw II learning strategy on senior secondary II students' attitudes towards Heat energy measurement in Sokoto State, Nigeria.

Problem Statement/ Justification

Despite the importance of Physics to national development, the situation of students performance in Physics examinations in Nigeria such as Senior School Certificate Examination (SSCE) organized by West Africa Examination Council (WAEC) and National Examination Council (NECO) has been unsatisfactory, Chief Examiners' reports indicate that in such examinations students could not provide correct explanations of evaporation, working principle of refrigerator, and conversion of heat energy to mechanical energy. They could hardly state correctly four factors which affect the rate of evaporation and could hardly understand basic concepts such as boiling point of liquids and principles of Physics in heat energy. Furthermore, the chief examiners pointed out that many students could hardly go beyond reproduction of the basic formula for linear expansivity, and were unable to interpret statements into workable diagrams; Students exhibited poor manipulation of arithmetic processes, and were unable to relate the principle of latent heat of vaporization to the preservation of tomatoes in most jute bags. Students defined specific heat capacity instead, when they were asked to define heat capacity (NECO, 2009-2012: WAEC. 2015, 2017). This may be a contributing factor to the persistent fluctuation and not too impressive outcome in the Physics examinations. This persistent fluctuation and not too impressive outcome have also been attributed to ineffective methods of teaching Physics, such as the Conventional lecture method, employed by teachers in the classroom and the lack of motivation that such methods present to the students, among others (WAEC, 2015 & NECO, 2011, 2012). Boyo's (2010) study on identifying problems associated with Studying Physics revealed that the lecture method of teaching is ineffective and is Still being employed in the Physics classroom in Nigeria. This method of teaching Physics, which is not student-centred, seems not to improve students' attitudes towards learning the subject. Moreover, the use of lecture method of teaching by teachers in teaching Physics in Secondary Schools contradicts the use of contemporary, student-centred methods of teaching advocated for by Nigerian Educational Research and Development Council (2008).

There are other factors, however, which also contribute to students' poor performance (and subsequent low Performance) in Physics. These include dearth of qualified and experienced Physics teachers in secondary schools, poor environmental conditions for schooling, poor funding and mismanagement of available resources, large class size in most public schools. teachers' inability to cover syllabus, reliance on examination malpractice by some schools, and poor studying habits amongst students (Boyo, 2010; NECO, 2012; Sule & Mankilik, 2015; WAEC, 2015).

The consequences of allowing the afore-mentioned problems to persist cannot be under-estimated. This is because the gradual and subsequent decline in the understanding of Physics will affect other Physics-related fields such as medicine, agriculture and engineering which will lead to decline in the health and socio-economy of the nation. This implies that technological advances that drive the economic engines of the nation will gradually collapse. Consequently, the quality of life of the people will deteriorate. The problem, therefore, is to find a method of teaching which will improve secondary school students' attitudes toward learning Heat energy measurement in Sokoto and which will subsequently improve their performance in the subject.

Objectives of the Study

The aim and objectives of this study is to investigate the effects of jigsaw II learning strategy on senior secondary II students' attitudes towards learning heat energy measurement in Sokoto State, Nigeria.

The specific objectives of the study are to:

1. find out whether the difference exists between attitudes of secondary school students towards heat energy measurement before and after exposure to jigsaw II learning strategy.
2. Determine whether the difference exists between attitudes of students taught with jigsaw II learning strategy and those taught with conventional lecture method.
3. investigate if there is difference between male and female students' attitudes taught heat energy measurement using jigsaw strategy in Secondary schools in Sokoto State.

Research Questions

The following research questions were raised to guide the study:

1. What is the difference between the pre-test and posttest mean attitude scores of Students in heat energy measurement exposed to jigsaw II learning strategy?
2. What is the difference in the post-test mean attitude scores of students taught heat energy measurement using jigsaw II learning strategy and their counterparts taught using lecture method in Secondary schools in Sokoto State, Nigeria?
3. What is the difference between the mean attitude scores of male and female students taught physics before and after using jigsaw II learning strategy in Secondary schools in Sokoto State, Nigeria?

Research Hypotheses

The following null hypotheses were tested in the study at 0.05 level of significance:

1. There is no significant difference between the pre-test and posttest mean attitude scores of students exposed to jigsaw II learning strategy.
2. There is no significant difference between the post-test mean attitude scores of the students taught physics using jigsaw II learning strategy and their counterparts taught using conventional lecture method in Secondary schools in Sokoto State, Nigeria.
3. There is no significant difference between the post-test mean attitude scores of male and female students taught physics using jigsaw II strategy in Secondary schools in Sokoto State, Nigeria.

METHODS AND PROCEDURE

The study adopted a quasi-experimental research design, specifically, the pretest-posttest non-equivalent control group design in which intact groups will be assigned to the experimental and control groups. The design was appropriate for the study because the random assignment of students to either of the two groups was not possible as the researcher used the normal lecture period to administer the treatment. Two groups were used for the design. One assigned experimental group and the other control group.

The design is to compare the gain attitude scores towards learning heat energy measurement of two groups so as to ascertain the effects of jigsaw II learning strategy on Physics students' attitudes towards learning heat energy measurement.

Population and Sample

The population for this study consists of the entire SS II students who are offering Physics in all Secondary Schools in the three Educational zones of Sokoto State from which 110 students from intact classes of three schools were sampled using purposive sampling technique. The reason for choosing SS II students for the study is due to the fact that they are not yet close to write external examination in Physics. Also such students would have experienced physics teaching for at least one year and so would be able to appreciate the effect of new teaching method. Moreover, the aspects of heat energy measurements which was used in the study fall within the SS II Physics curriculum.

The instrument used for data collection in this study is Students' Attitudes towards Physics Questionnaire (SATPQ).

To ensure face and content validity of Students' Attitudes towards Physics Questionnaire (SATPQ), the questionnaire was given to three experts, in Physics Education, Measurement and Evaluation and Psychology respectively. To ensure construct validity of SATPQ, factor analysis was conducted on SPSS software. This because factor analysis provides evidence of the construct validity of the questionnaire. A copy of SATPQ was given to each of the above-mentioned experts for the validation alongside the objectives of the study, research questions and hypotheses.

Procedure

Two research assistants were employed in each of the three sampled schools to help the researchers to carry out the treatment to experimental and control groups. The research assistants were Physics teachers of the sampled schools. The researchers used six days to train the research assistants. The training was accomplished using Lecturer's Instructional Guide for Jigsaw cooperative learning strategy (LIGJ) and Lecturer's Instructional Guide for Conventional Lecture Method (LIGL), in conjunction with the lesson plans.

Prior to treatment on the experimental group, the instrument was administered as pretest to all the sample in the two groups. This administration was done one week before starting the treatments.

Treatment was administered to the experimental group for a period of seven weeks while the control group was merely engaged during the same period using the conventional lecture method. The experimental group were taught the concepts of heat energy measurement twice a week using jigsaw cooperative learning strategy. In the experimental group, students were grouped into heterogeneous groups of 3 to 5 students, depending on the activities in the lesson. The Sitting arrangement in the groupings in the experimental group was structured such that students in each group could interact with one another during lesson. They were instructed to cooperate with each other in their group, learn their portion of the given tasks and teach the others. Moreover, they were instructed to ask each other questions for clarity. After summarizing the lesson by the teacher, worksheets were marked and scored by the teacher for the various groups and given back to groups to know their scores. The Control group were also taught the same concepts twice a week, but using conventional lecture method of teaching. To ensure that the students were not aware that they will be used for experiment, the research assistants, being lecturers in the sampled colleges, were used for the treatment. The researcher was monitoring the research assistants at the different locations. Treatment commenced a week after pretest was administered to both groups.

Administration of Posttest

After treatment, posttests were administered to the groups using SATPQ. Posttests was administered so as to determine whether the experimental and control groups differ in the posttest mean scores of attitudes in the concepts of Heat energy measurement.

Descriptive statistics (mean and standard deviation) using Statistical Package for Social Sciences (SPSS) software was employed to answer all the three research questions. Hypothesis one was tested using t-test as it is concerned with only one group (experimental group) while the remaining two hypotheses were

tested using Analysis of Covariance (ANCOVA), which is a parametric test, on the SPSS version. In this case, ANCOVA was used because, apart from covering the after-effect of the different treatments, it is interested in the initial ability of the subjects (Sidhu, 2007). This shows that both pretest and posttest scores were taken into consideration in testing the formulated hypotheses.

RESULTS

The results are analyzed and presented under research questions and hypotheses.

Research Question 1: *What is the mean attitude scores of students in heat energy measurement before and after exposure to jigsaw II learning strategy?*

Table 1: Students Mean attitude Scores Before and After Exposure to Jigsaw II Learning Strategy

Group	Test	N	Mean	S. D	Mean difference
	Before	60	37.50	5.74	
Jigsaw II Learning Strategy					27.40
	After	60	64.93	7.62	

Table 1 revealed that the mean attitude scores of students before and after exposure to jigsaw II learning strategy was 37.50 and 64.93 with standard deviation of 5.74 and 7.62 respectively with mean attitude difference of 27.40 in favour of after exposure to jigsaw II learning strategy. This indicated that after exposure to treatment using exposure to jigsaw II learning strategy the attitude has improved.

Research Question 2: *What is the difference in the post-test mean attitude scores of students taught physics using jigsaw cooperative learning strategy and their counterparts taught using conventional lecture method?*

Table 2: Post-test Mean attitude Scores of Students taught Physics using Jigsaw Cooperative Learning Strategy and those taught using Conventional Lecture Method

Group	N	Mean	S. D	Mean difference
Jigsaw II Learning Strategy	60	64.93	7.62	
				23.01
Conventional Lecture Method	50	41.92	9.61	

Table 2 presented that the post-test mean attitude scores of students taught Physics using jigsaw cooperative learning strategy and those taught using conventional lecture method was of 64.93 and 41.92 with standard deviation of 7.62 and 9.61 respectively with mean attitude difference of 23.01 in favour of students who were exposed to jigsaw cooperative learning strategy. This indicated that jigsaw II learning strategy is more effective than conventional lecture method in enhancing students' attitude.

Research Question 3: What is the difference between the mean attitude scores of male and female students taught physics before and after using jigsaw II learning strategy?

Table 3: Mean attitude Scores and Standard Deviation of Male and Female Students

Gender	N	Before		After		
		Mean	S. D	Mean	S. D	Mean difference
Male	45	38.13	5.93	66.00	7.87	27.87
Female	15	35.60	4.79	61.73	5.95	26.13
						1.74

The results in Table 3 reveal that the before mean scores for male and female were 38.13 and 35.60 with standard deviation of 5.93 and 4.79 respectively while the after mean scores were 66.00 and 61.73 with standard deviation of 7.87 and 5.95 respectively. The mean difference of both genders was 1.74. This

difference though small is in favour of the male students. This implies that male students performed slightly higher than their female counterparts when taught physics using jigsaw II learning strategy.

Hypothesis One

There is no significant difference between the mean attitude scores of students in physics before and after exposure to jigsaw II learning strategy.

Table 5: t-test of Independent Samples Analysis of Students' Mean attitude Scores Before and After Exposure to Jigsaw II Learning Strategy

Group	Test	N	Mean	S. D	df.	t-value	*P-value*	Decision
	Before	60	37.50	5.74				
JCLS					118	-22.28	0.000	Rejected
	After	60	64.93	7.62				

Table 5 presented the t-test of independent sample analysis of students' mean attitude scores before and after exposure to jigsaw II learning strategy. The attitude mean scores of students before and after exposure to jigsaw II learning strategy was 37.50 and 64.93 with standard deviation of 5.74 and 7.62 respectively. The mean attitude difference of the students before and after exposure to jigsaw II learning strategy was 27.40. The df of 118, t-value of -22.28 and P-value of 0.000 was found. Since the P-value of 0.000 is less than the 0.05 level of significance (0.000<0.05) null hypothesis was rejected. Therefore, the null hypothesis which states that there is no significant difference between the mean attitude scores of students in physics before and after exposure to jigsaw cooperative learning strategy was rejected. This indicated that students attitude differ significantly after they were exposed to jigsaw cooperative learning strategy. This implies that jigsaw II learning strategy significantly enhances students' attitude.

Hypothesis Two

There no significant difference between the post-test mean attitude scores of the students taught physics using jigsaw cooperative learning strategy and their counterparts taught using conventional lecture method.

Table 6: t-test of Independent Samples Analysis of Post-test Mean attitude Scores of Students taught Physics using to Jigsaw II Learning Strategy and Conventional Lecture Method

Group	N	Mean	S. D	df.	t-value	*P-value*	Decision
Jigsaw II Learning Strategy	60	64.93	7.62				
				108	14.003	0.000	Rejected
Conventional Lecture Method	50	41.92	9.61				

Table 6 presented the t-test of independent sample analysis of students' mean attitude scores of students taught physics using to jigsaw cooperative learning strategy and conventional lecture method. The post-test means scores of students taught physics using to jigsaw II learning strategy and conventional lecture method was 64.93 and 41.92 with standard deviation of 7.62 and 9.61 respectively. the mean post-test difference of the students taught physics using to jigsaw II learning strategy and conventional lecture method was 23.01. The df of 108, t-value of 14.003 and p-value of 0.000 was found. Since the P-value of 0.000 is less than the 0.05 level of significance (0.000<0.05) null hypothesis was rejected. therefore, the null hypothesis which states that there is no significant difference between the post-test mean attitude scores of the students taught physics using jigsaw II learning strategy and their counterparts taught using conventional lecture method was rejected. This indicated that the mean post-test scores of students taught physics using to jigsaw II learning strategy and those taught using conventional lecture method differ significantly. This implies that jigsaw II learning strategy is more effective in enhances students' attitude than conventional lecture method.

Hypothesis Three

There is no significant difference between the post-test mean scores of male and female students taught physics using jigsaw strategy.

Table 7: Summary of Analysis of Covariance (ANCOVA) of Male and Female Students' attitude when taught Physics using Jigsaw II Learning Strategy

Source	Type III Sum of Squares	Df	Mean Square	F	*P*-value	Decision
Corrected Model	208.433[a]	2	104.217	1.845	.167	
Intercept	5168.669	1	5168.669	91.515	.000	
Pretest	3.633	1	3.633	.064	.801	
Gender	186.993	1	186.993	3.311	.074	Retained
Error	3219.300	57	56.479			
Total	256408.000	60				
Corrected Total	3427.733	59				

The Analysis of Covariance (ANCOVA) result from Table 7 revealed that F-value (1,59) for the gender was found to be 3.311 with significant difference of *P*-value at 0.74, P(0.74>0.05). The P-value 0.74 is greater than level of significance 0.05. The null hypothesis three was therefore, not rejected. This implies that there is no significant difference between the post-test mean scores of male and female students taught physics using jigsaw strategy. This implies that using jigsaw II strategy is a gender friendly strategy that enhanced both male and female students' attitude rowards physics.

DISCUSSION OF FINDINGS

The finding from this study revealed that, the attitude of students taught physics using jigsaw II learning strategy increased significantly higher than their counterparts taught using conventional lecture method. This finding agreed with the position of (Johnson & Lawal, 2022; Phuntsho & Gyeltshen, 2022) in their separate studies found that students who were taught using jigsaw cooperative learning strategy performed higher than their counterparts taught using conventional lecture method. Based on this finding it was established that, jigsaw cooperative learning strategy has more impact than conventional lecture method in enhancing students' Performance.

The finding revealed that, students taught physics using jigsaw cooperative learning strategy have positive attitude toward physics than their counterparts taught using conventional lecture method. This finding is in accord with that of (Abobaker & Abdel Rahman, 2019; Abdel-Mordy, Sabry & Mahmoud, 2022) found that students who were taught using jigsaw cooperative learning strategy have positive attitude than their counterparts of conventional lecture method. This revealed that, jigsaw cooperative learning strategy has more impact than conventional lecture method in enhancing students' attitude toward learning physics. Based on this finding, it was established that, jigsaw cooperative learning strategy enhances attitude toward learning physics better than conventional lecture method that is regularly use by physics teachers.

The finding also revealed that, there was no significant difference in male and female students' Performance scores when taught physics using jigsaw cooperative learning strategy. This finding is in agreement with that of (Suleiman, Musa & Munir, 2021; Johnson & Lawal, 2022) who in their separate studies found that gender has no effect on male and female students' Performance when using jigsaw cooperative learning strategy is used as the medium of instruction. This revealed that male and female students are capable of competing when jigsaw cooperative learning strategy is used as medium of instruction and that attitude is a function of orientation not gender. Therefore, jigsaw cooperative learning strategy is a gender-friendly instructional approach that can be used to close the gender-attitudinal gap in toward learning physics and science subjects in general.

The likely explanation for these findings may be connected to the fact that jigsaw II learning strategy encourages students' active participation during the teaching and learning processes.

Summary of Findings

The following findings were made from this study:

1. After exposure to treatment using jigsaw II learning strategy the attitudes of students in Physics has improved.
2. Jigsaw II learning strategy enhanced students' attitude in Physics more than conventional lecture method that is popular and commonly used by Physics teachers.
3. The male students attitudes improved slightly higher than their female counterparts when taught physics using jigsaw II learning strategy.
4. After students were exposed to treatment using jigsaw cooperative learning strategy they have developed better attitude toward Physics.
5. There is no significant difference between the mean attitude scores of students in physics before and after exposure to jigsaw II learning strategy in Sokoto State, Nigeria ($0.000<0.05$).
6. There is significant difference between the post-test mean attitude scores of the students taught physics using jigsaw cooperative learning strategy and their counterparts taught using conventional lecture method in Sokoto State, Nigeria ($0.000<0.05$).

CONCLUSION

Based on the findings and discussion from this study, it is concluded that: the use of using jigsaw cooperative learning strategy is proven to enhanced students' attitude and Performance in physics than the use of conventional lecture method. Jigsaw cooperative learning strategy is very effective in-terms of students' attitude and Performance irrespective of gender for it was revealed that there is no gender disparity in the male and female students' attitude and Performance when taught physics using jigsaw cooperative learning strategy. Therefore, jigsaw cooperative learning strategy is gender-friendly strategy as male and female students equally benefited.

The study provided evidence that jigsaw II learning strategy could be used to close the gender gap in the attitude of students in physics. It also indicated that there is no interaction effect between treatment and gender on students' Performance in physics. This implies that there is no need for separation of instructional strategy for male and female students since jigsaw cooperative learning strategy could be used successfully for the two gender. Therefore, jigsaw cooperative learning strategy can be used to address the present challenge of students' poor attitude and Performance in physics.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations are put forward.

1. Professional bodies like Science Teachers Association of Nigeria (STAN) should organize seminars and workshops on jigsaw II learning strategy to stimulate and popularize their use in classrooms.
2. Physics teachers should be encouraged to use jigsaw II learning strategy as method of instruction that they can apply in order to improve their teaching, students' attitude and Performance in physics.
3. Jigsaw II learning strategy is an effective gender-friendly strategy that should be applied to maximize learning among students irrespective of their gender.

ACKNOWLEDGEMENT

We are hereby acknowledged and express our heartfelt appreciation to the Tertiary Education Trust Fund (TET fund) for providing financial support without which the work cannot be possible. I must commend my Institution, Federal College of Education, Gidan Madi, Sokoto State for their effort and encouragement given throughout the period of this research work.

REFERENCES

Abdel-Mordy, M. A., Sabry, S. S., & Mahmoud, A. A. (2022). Effect of cooperative jigsaw learning strategy on community nursing students' attitude and Performance. *International Egyptian*

Journal of Nursing Sciences and Research (IEJNSR), 2(2), 487-500. https://doi.org/10.21608/ejnsr.2021.107840.1133

Abdullah, A., & Filiz, B. (2017). The effects of jigsaw technique on the students' laboratory material recognition and usage skills in general physics laboratory course. *Universal Journal of Educational Research,* 5(7), 1073-1083. Retrieved from http://www.hrpub.org DOI: 10.13189/ujer.2017.050701

Abobaker, R. M., & Abdel Rahman, H. M. (2019). Effect of lecture versus jigsaw teaching strategies on maternity nursing students' attitudes and academic Performance. *Egyptian Journal of Health Care (EJHC),* 10(3), 481-492.

Adesoji, F.A. (2008). "Managing students' attitudes towards science through problem-solving instructional strategy."*Anthropologist*, *10*(1). 21-24

Aina, J. K. (2013). Importance of science education to national development and problems militating against its development. *American Journal of Educational Research 1*(7) 225-229.doi: 10.12691/education-1-7-2.

Aina, J. K., & Akintunde, Z. T. (2014). Course contents analysis of students' academic performance in basic electronics. *International Journal of Learning, Teaching and Educational Research, Research, 1*(1), 25-34.

Aronson, E., & Patoe, S. (1996). *The jigsaw classroom: Building cooperation in the classroom*. New York, Addison Wesly: Longman.

Bukar, A. (2019). *Effects of motivational model on Students' attendance and academic Performance in Science and technology colleges, Yobe State, Nigeria:* Unpublished Msc.Ed. Thesis, University of Jos.

Idris, S. (2018). *Physics education as a panacea to the national security challenges in Nigeria.* A Paper Conference Presented at the 11th Annual National Conference of School of Arts and Social Sciences, College of Education, AzareBauchi State.

Johnson, F. O., & Lawal, R. F. (2022). Effect of smartphone-assisted jigsaw cooperative learning on senior secondary school students' Performance in mathematics within education district iv, Lagos State. *International Journal of Educational Research,* 5(4), 1-9. https://doi.org/10.5281/zenodo.679095

National Commission for Colleges of Education (2012). *Minimum standard in sciences* (3rd ed.) Abuja: NCCE

NTNU (2016). *Physics education*. Retrieved August 19, 2017 from http//www.ntnu.edu/physics. Norwegian University of Science and Technology.

Olusola, O.O. & Rotimi, C.O. (2012). *Attitudes of students towards the study of physics in college of education Ikere Ekiti, Ekiti State, Nigeria*

Omosewo, E. O. (2009). Views of Physics teachers on the need to train and retrain Physics teachers in Nigeria. *African Research Review, 3*(1), 314-325

Oniyangi, D. O. (2013). The impact of curriculum content and community support on primary schools' academic Performance in central Nyanza region, Kenya. *International Journal of Science and Research,* 4(1).

Phuntsho, S., & Gyeltshen, T. (2022). Effectiveness of jigsaw cooperative learning approach in mathematics: A study in a middle secondary school in Bumthang district. *Interdisciplinary Journal of Applied and Basic Subjects*, 2(4), 1-10. https://identifier.visnav.in/1.0002/ijabs-22d-07002/

Shahr, M. J., Matlabi, M., Esmaeli, R., & Kianmehr, M. (2017). Effectiveness of teaching: Jigsaw technique vs Lecture for medical students' physics course. *Bali Medical Journal, 6*(3).

Sidhu, K. S. (2007). *Statistics in education and psychology*. New Delhi: Sterling Publishers Private Ltd.

Suleiman M. B., Musa O. D., & Munir, A. (2021). Effect of jigsaw ii cooperative learning strategy (J2CLS) on academic Performance of senior secondary students in Physics within Bauchi Metropolis. A paper presented at the 2nd National Conference on: Issues in STEAM Education

in the 21st Century, dated: 30th May – 2nd June, 2021, at Department of Science and Technology Education, Bayero University Kano, Kano State, Nigeria.

Surian, A., & Damini, M. (2014). Becoming a cooperative learner-teacher.*Anales de psicologia, 30*(3) 808-817. Retrieved from http://dx.doi.org/10.6018/analesps. 30.3.201521

Ukoh, E. E. (2013). Determining the effect of interactive invention instructional strategy and gender on NCE pre-service teachers' acquisition of science process skills. *An International Multidisciplinary Journal, Ethiopia, 7*(3),143-155.

Wanbugu, P.W., Changeiywo, J. M., & Ndiritu, F. G. (2013). Effects of experiential cooperative concept mapping instructional approach on secondary school students' Performance in physics in Nyeri county, Kenya. *Asian Journal of Social Sciences & Humanities, 2*(3), 275-296.