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The Effectiveness Of Jigsaw Instructional Strategy On Senior School Students' Attitude Towards Physics In Jos, Nigeria

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Abstract: ***Students' poor performance in physics has been linked to negative attitude towards the subject, inappropriate instructional strategies, and inadequate human and material resources, among others. Jigsaw Instructional Strategy (JIS) has been used in Nigeria and other parts of the world for the improvement of students' attitude towards different subjects. The objective of the study was to determine the effect of JIS on students' attitude towards physics. The study was a quasi-experimental, pre-test and post-test control group design. Purposive sampling technique was used to select two schools, from which two intact classes of senior secondary school two students in physics were involved in the study. A total of 84 students comprising the experimental and control groups (experimental group = 43; control group = 41) took part in the study. The instrument used for data collection was Physics Students' Attitude Questionnaire (PSAQ), adapted from Fraser's test of science related attitude. The reliability of PSAQ was ensured using Cronbach Alpha Coefficient with reliability Coefficients of 0.99. Four research questions raised in the study were answered using frequency, percentage, mean and standard deviation while the hypotheses formulated were tested using t-test and Analysis of Variance at 0.05 level of significance. The findings from the study showed that JIS improved students' attitude towards physics irrespective of gender and score level. It was recommended that teachers should include the use of jigsaw instructional strategy for improving the teaching and learning of physics in senior secondary schools.***

Keywords: jigsaw instructional strategy, attitude, physics

I. INTRODUCTION

Science is defined as an activity which results into a testable, falsifiable and veritable body of knowledge (Omosewo, 2009) while technology is the practical application of science; the application of science through technology is crucial for providing the infrastructures that all modern countries need. The goals of education as stated in the National Policy on Education (FRN, 2013, p.2), among others is the development of appropriate skills, mental, physical and social abilities and competencies to empower an individual to live in and contribute positively to the society. One of the objectives of post basic education which includes secondary school education as stated in the National Policy on Education (FRN, 2013, p.12) is to provide trained manpower in the applied sciences, technology and commerce at sub-professional grades.

Physics is a branch of science that is concerned with energy and their interaction (Omosewo, 2009); and it is the most basic of the sciences because its concepts and techniques corroborates the progress of all branches of science (Ekee, 2010). Physics is a cross cutting discipline that has been implemented in many sectors of economic advancement which includes health, agriculture, water, energy and information technology. In medicine, x-rays, radioisotope and resonance imaging, are used. In addition, the design of machines and electronics all depend on advances made from the principles of physics.

The technologies associated with physics, especially space and nuclear science; determine the economic and military powers of nations (Manklik & Ofodile, 2015). Among the three core sciences; biology, chemistry and physics, physics plays a vital role in all human endeavour and serves as a pre-requisite for courses such as medicine,

geology, computer engineering, forestry, space navigation, agricultural science, pharmacy, among others. Physics, as a science subject at the senior school level is an important subject that is required for the scientific and technological development of any nation.

The Nigerian government in recognition of the importance of science and technology, especially physics has taken important steps towards its development. One of these steps included the implementation of the Science and Technology Education Post Basic project with support from the World Bank which focuses on the production of sufficient and quality science and technology graduates. Also, the inclusion of "physics in technology" in the 2009 review of senior secondary school physics curriculum was a significant step towards the improvement of science and technology in Nigeria (Mankilik & Ofodile, 2015).

Students' low enrolment and poor achievement in physics is an indication of an inconsistency between the expectations of the Nigerian government and the actual situation of physics in our schools and this calls for a review of the strategies teachers adopt in the teaching and learning of physics. The West Africa Examination Council (WAEC) Chief examiners' reports (2014 & 2015) in physics when compared with other science subjects, indicated low enrolment and poor performance of students generally despite the favourable standards of the paper and the moderate severity of the marking scheme. In line with this, the analysis of the WASSCE results of candidates' performance in physics for the May/June 2007-2016 SSCE in Nigeria indicated general poor performance. Table 1 summarizes the enrolment and performance of physics students in WASSCE for ten years. Table 1 shows that the number of candidates who enrolled for physics (5 510 928) is low compared to the enrolment of candidates in biology (13 492 823) and chemistry (5 598 689) in ten years.

Table 1 also shows that the performance of students' in the science subjects (biology, chemistry and physics) has been below and a little above average over the years. The performance of students in physics fell below average especially in the years 2007, 2008 and 2013. Even though the performance of students in physics in external examinations was above average in the years 2009, 2010, 2011, 2012, 2014, 2015 and 2016; there is still need for improvement in the performance of students in physics.

Year	Biology			Chemistry			Physics		
	Total sat	Credit passed (A1-C6)	% pass	Total sat	Credit passed (A1-C6)	% pass	Total sat	Credit passed (A1-C6)	% Pass
2007	1,238,163	413,211	33.37	424,747	196,063	46.16	409,449	180,797	44.16
2008	1,259,964	427,644	33.94	456,980	202,762	44.37	408,237	200,345	49.08
2009	1,259,964	453,928	33.87	456,980	203,365	43.49	444,236	222,722	50.14
2010	1,300,418	427,644	32.88	465,643	263,059	50.70	463,755	237,756	51.27
2011	1,505,199	579,432	38.50	565,692	280,250	49.54	563,161	360,096	63.94
2012	1,646,150	587,044	35.66	627,302	270,570	43.13	624,658	429,415	68.74
2013	1,648,363	852717	51.73	639,296	462,517	72.34	637,023	297,988	46.77
2014	1,365,384	766,971	56.17	636,268	397,649	62.49	635,729	386,270	60.76
2015	1,181,535	627,770	53.13	658,650	458,547	69.61	657,850	391,114	59.45
2016	1,087,683	802,483	73.77	667,131	546,733	81.95	666,830	508,367	76.23

Source: Statistics Section, WAEC Office Yaba Lagos, 2017

Table 1: *Candidates' Enrolment and Performance in Nigerian May/June Senior School Certificate Examinations in Biology, Chemistry and Physics: 2007-2016*

A number of factors have been identified as militating against students' attainment of the objectives of physics instruction, and the most common factor identified by researchers is the inappropriate instructional strategies adopted by science teachers, (Cheema & Mirza, 2013). Many investigations have shown that secondary school students have negative attitude towards physics (Akinbobola , 2015); physics also remain one of the most difficult subjects in the senior secondary school curriculum because Nigeria has witnessed persistent poor students' performance in physics at the senior school certificate level (Ogunleye & Babajide, 2011). This has been linked to the adoption of instructional strategies which did not give enough consideration to learners' previous knowledge and how they reasoned in order for learners to construct their own knowledge. Attitude of students' towards physics is another major cause of students' low performance in physics; Researchers have reported negative attitude of students towards sciences and found that active learning strategies have brought about positive attitudes towards physics (Akinbobola, 2009; Abdul, Muhammad & Manzoor, 2011; Akinbobola, 2015).

The jigsaw instructional strategy (JIS) is a cooperative learning strategy that promotes active learning because it encourages effective collaboration among students, and increases students' investment and motivation. JIS is an active learning exercise where students participate in group discussions, learn by themselves and teach other peers what they have learnt. The main steps in JIS are;

- ✓ a topic is divided into subtopics (puzzle divided into pieces);
- ✓ each member of a team/group is assigned to read and become an expert on different subtopics;
- ✓ after each person has become an expert on their subtopics (piece of the puzzle), they teach other team members that subtopic (puzzle piece);
- ✓ after each person has finished teaching, the puzzle has been reassembled and everyone in the team knows something important about every subtopic (piece of the puzzle) (Aronson, 2008).

STATEMENT OF PROBLEM

The enrolment and performance of students' in Nigeria senior secondary schools in physics have not been impressive especially in the ten years under review. This, in turn would not favour the nations strive towards advancement in science and technology. The utilization of active learning strategies such as the jigsaw instructional strategy in science fields have been found to bring about positive attitude of students towards science subjects (Kaya and Boyuk (2010). This study therefore aims at finding out the effectiveness of jigsaw instructional strategy on senior school students' attitude towards physics in Jos, Nigeria.

II. LITERATURE REVIEW

Attitude, is the opinion and feeling that a person, usually have about something (Della, 2008). Attitude is considered as a mental and natural state of readiness, organized through experiences, exerting a direct influence upon an individual's response to all objects and situations with which it is related (Fasakin, 2012). In addition, Erdemir and Bakirci (2009)

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defined attitude as tendency for individuals who organize thoughts, emotions, and behaviours towards a psychological object. Yara (2009) defined attitude towards science as interest or feeling towards studying science or the scientific approach assumed by an individual for solving problems, assessing ideas and making decision. Human beings are not born with attitudes they learn afterwards. Some attitudes are based on peoples' own experience, knowledge and skills and some are gained from other sources (Fatoba and Aladejana, 2014). However, the attitude does not stay the same at all times. It changes in a couple of time and gradually. Social psychologists have viewed attitudes as having three components: cognitive, affective and behavioural (Gok & Silay, 2010).

Attitude towards physics as a subject deals with the beliefs, interest, perceptions and aspirations, feelings, habits, persistence and self-concept of students in dealing with the subject (Akinbobola, 2015). Being an evaluative dimension, it is acquired through learning and can be changed through persuasion using different techniques (Akinbobola, 2009). Yara (2009) in his findings reports that many students developed negative attitudes to science learning, probably due to the fact that teachers are unable to satisfy their aspiration or goals. Alebiosu and Michael (2011) recommended the use of active learning strategies (concept maps) in improving the attitude of senior secondary students to physics.

Akinbobola (2009) conducted a study find out the attitude of students towards the use of cooperative, competitive and individualistic learning strategies in Nigerian senior school physics. 140 students were involved in the study and data were collected using a structured questionnaire, analysis of data was done using ANOVA. Cooperative learning strategy was found to be the most effective in facilitating student's attitude towards physics, followed by competitive strategies and individualistic learning strategies respectively. The results also showed that there was no significant gender difference in the attitude of students toward physics when they were taught using cooperative, competitive and individualistic learning strategies.

Akinbobola and Ikitde (2010) investigated the facilitating effect of models, realia and charts on students' attitude in teaching the concept of heat energy in Nigerian senior secondary school physics. 183 senior school two physics students were selected from Ife South Local Government Area of Osun State for the study. Physics attitude scale (PAS) was used to collect data, and analysis of data was done using analysis of ANCOVA. The findings from the study showed that models were the most effective in facilitating students' attitudes towards learning physics, followed by realia and charts respectively in facilitating students' attitude towards physics learning. The results also showed an insignificant gender differences in the attitude to be the least effective in facilitating students attitude towards physics learning.

Kaya and Boyuk (2010) examined the attitude towards physics lesson and physical experiments of the high school students in Kayseri, Turkey. The population of the study consists of high school students from the schools in the Kayseri province centre. The sample of the study was 295 students selected from the population by random sampling. A questionnaire consisting 12 items, on students' attitude towards physics lessons and 8 items on physical experiments was the instrument used in the study. Analysis of data was done using *t*-test and ANOVA. The findings from the study showed that students' attitudes towards physics lessons and physical experiments were 63.07, which is higher than the indecisive level, 60 in the research. Some of the students are indecisive about physics lessons and physical experiments, and also, there are as many students of negative opinion as those with a positive opinion.

Abdul, Muhammad and Manzoor (2011) conducted a research which measured students' attitudes towards learning physics. The study aimed at measuring students' ability in using of Science Process Skills through 5Es Learning Cycle Model (Engagement, Exploration, Explanation, Elaboration and Evaluation) and traditional teaching method of teaching Physics. The sample of the research was 40 tenth graders among which experimental and control groups were selected randomly. The experimental group was taught using the 5Es Learning Cycle Model while the traditional teaching method was used to teach the control group and data analysis was done using *t*-test. The result of the research showed that the students in the experimental group had a positive change their attitude in learning physics than the control groups.

Ibeh, Onah, Umahi, Ugwunah, Nnachi and Ekpe (2013) found that qualified/professional physics teachers, adequate instructional materials, equipment, teaching aids and tools, management/government intensive funding, motivation of both teachers and students, comfortable learning environment, recommendation of textbooks can be used to improve the attitudes of senior school students towards physics for sustainable technological development.

Sengul and Katranci (2014) investigated the effects of jigsaw technique on seventh grade primary school students' attitude towards mathematics in Sarkaya province of Turkey. 33 students were selected for the study and were taught transformation geometry. Data were collected using an attitude scale named "Your opinion about mathematics" and data obtained were analysed using frequency, percentage and t-test. They found that there were no significant differences between the pre-test attitude and post-test attitude scores of students. It was concluded that the jigsaw technique had no effect on improving students' attitude towards mathematics.

Akinbobola (2015) conducted a research on the effects of pictorial, written and verbal advance organizers on students' attitude in Nigerian senior secondary school Physics. 180 senior school two physics students were selected for the study. The instrument used for data collection was students' attitude towards physics questionnaire (SATPQ) and data collected were analysed using *t*-test and ANCOVA. The results of the study showed that pictorial organizer was the most effective in enhancing students' attitude towards learning physics, written organizer and verbal organizer was found to be the least effective. Active learning strategies, of which jigsaw instructional strategy is one, have been found to bring about positive attitude in students; it is to this end that this study finds out the effect of jigsaw instructional strategy on senior school physics students' attitude.

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RESEARCH QUESTIONS

- ✓ What difference exists between the attitude level scores among students that learn physics using jigsaw instructional strategy and those that learn using conventional method?
- ✓ What difference exists in the pre-attitude and post-attitude level scores among students that learn physics using jigsaw instructional strategy?
- ✓ How do the attitude scores among students differ when they learn physics using jigsaw instructional strategy based on gender?
- ✓ Is there any difference between the mean attitude scores among students that learn physics using jigsaw instructional strategy based on score level?

RESEARCH HYPOTHESES

HO_1: There is no significant difference in the mean attitude scores among students that learn physics using jigsaw instructional strategy and those that learn using conventional method.

HO_2: There is no significant difference in the pre-attitude and post-attitude scores among students that learn physics using jigsaw instructional strategy.

HO_3: There is no significant difference in the mean attitude scores among students that learn physics using jigsaw instructional strategy based on gender.

HO_4: There is no significant difference in the mean attitude scores among students that learn physics using jigsaw instructional strategy based on score level.

III. METHODOLOGY

The study adopted the quasi-experimental research, of the pre-test, post-test control group. The area of study was Jos metropolis which constitutes parts of Jos south and Jos north local government areas of Plateau State, Nigeria. The population comprised of 84 senior secondary school two students offering physics from two purposively selected schools. Students from two intact classes (one from each participating schools) were involved in the study, with 43 and 41students in the experimental and control groups respectively. Students in the experimental group were classified into three score levels (high, medium, low) based on the results obtained from their senior school one (SS1) third term continuous assessment in physics. Students whose scores fell between 70-100percent were classified as high scorers; students whose scores fell between 50-69 percent were classified as medium scorers while students whose scores fell between 0-49 percent were classified as low scorers.

Two research instruments were used to obtain data for this study. The researcher-designed Instructional Plans (IP) on the concept of simple harmonic motion for experimental and control groups and Physics Students' Attitude Questionnaire (PSAQ). PSAQ was adapted and modified from the test of science-related attitude (Fraser, 1982), which was developed in questioning students' attitude towards science. The science-related attitudes developed were tested and has been used in many research works. 29 items were selected from the test of science-related attitude and the word science was replaced with physics to suit this research. The items are classified under social implication of science, normality of scientist, attitude to scientific inquiry, adoption of scientific attitudes, enjoyment of science lessons, leisure interest in science and career interest in science. Table 2 shows the positive and negative items of PSAQ under seven components as classified by Fraser (1982).

S/N	Attitude components	Positive items	Negative items
1	Social implication of science	15, 16, 19	-
2	Normality of Scientist	26, 29	22
3	Attitude to scientific inquiry	27	17, 18, 20, 24
4	Adoption of scientific attitudes	6, 12, 28	2
5	Enjoyment of science lessons	1, 9, 23	5, 7, 21, 25
6	Leisure interest in science	3	4, 8, 10
7	Career interest in science	14	11, 13

Note. Adapted from "Test of Science-related Attitudes: A Handbook", by B.J. Fraser, Australian Council for Educational Research Limited, Hawthorn.

Table 2: the components of PSAQ

The questionnaire consists of two sections. Section A is composed of the bio data of the students; name of school and gender. Section B consists of 29 questions on the various components of students' attitude to physics. The purpose of this instrument is to determine whether students have favourable or unfavourable attitude towards physics after exposure to jigsaw instructional strategy. The questionnaire was constructed based on the Likert five-point scale of Strongly Agree (SA); Agree (A); Not sure (N); Disagree (D) and Strongly Disagree (SD) respectively. The minimum total average score that could also be obtained by a student was 1.00 while the maximum total average score that could be obtained was 5.00. Interval mean scores for the attitude levels were also obtained as 1.00 – 1.66, 1.67 – 2.33, 2.34 – 2.99, 3.00 – 3.66, 3.67 – 4.33, and 4.34 – 5.00 for strongly negative, moderately negative, weak negative, weak positive, moderately positive and strongly positive attitude levels respectively.

There were 14 questions raised on students' positive attitude towards physics and 15 questions on negative attitude towards physics in PSAQ. After obtaining students' response to PSAQ, negative items in students' response were converted to positive by changing the numbers assigned to the Likert five-point scale from strongly agree(5), agree(4), not sure(3), disagree(2) and strongly disagree(1); to strongly agree(1), agree(2), not sure(3), disagree(4) and strongly disagree(5). This was done to ensure that all responses were positive in order to determine if there was positive change in students' attitude towards physics.

IV. PROCEDURE FOR DATA COLLECTION

The researcher obtained permission from the constituted authorities of the two schools involved in the study. The physics teachers from each school assisted in distributing the questionnaire to the students and also taught the students using conventional method and jigsaw instructional strategy in the two schools respectively. Physics students' attitude questionnaire (PSAQ) was distributed to the students before the experiment to obtain the pre-attitude scores; and was also given to them after the experiment to obtain the post-attitude scores. The questionnaire was immediately retrieved by the researcher for onward analysis.

V. RESULTS

RESEARCH QUESTION 1

What difference exists between the attitude level scores among students that learn physics using jigsaw instructional strategy and those that learn using conventional method?

Table 3 showed the attitude level scores of students in the experimental and control groups after learning physics using jigsaw instructional strategy and conventional methods respectively. There were 43 students in the experimental group out of which 2% had high positive attitude, 89% had moderate positive attitude and 9% had low positive attitude towards physics while in the control group 41 students responded to the scale. 7% of the students had high positive attitude, 49% had moderate positive attitude, 34% had low positive attitude and 10% had low negative attitude towards physics. Students in the experimental group did not exhibit any negative attitude towards physics.

Attitude Levels	Mean Attitude Score Interval	EG		CG	
		f	%	*f*	%
High negative	1.00 – 1.66	0	0	0	0
Moderate negative	1.67 – 2.33	0	0	0	0
Low negative	2.34 – 2.99	0	0	4	10
Low positive	3.00 – 3.66	4	9	14	34
Moderate positive	3.67 – 4.33	38	89	20	49
High positive	4.34 – 5.00	1	2	3	7
		43	100	41	100

Table 3: Mean Attitude Level Scores of Students in Experimental and Control groups

HYPOTHESIS 1

There is no significant difference in the mean attitude scores among students that learn physics using jigsaw instructional strategy and those that learn using conventional method.

The analysis in Table 4 revealed the attitude scores of students in the experimental and control groups. The calculated t-value of -2.58 was computed with a degree of freedom of (1, 82) at 0.05 level of significance. Since the p-value of 0.01 was less than the alpha value, the null hypothesis 1 was rejected. This means that there was a significant difference in the mean attitude scores of students that learn physics using jigsaw instructional strategy (M = 3.85, SD = 0.17) and those that learn with conventional method (M = 3.65, SD = 0.46). This implies that students in the experimental group had a more positive attitude than their counterparts in the control group (t (82) = -2.58; p<0.05).

Group	*N*	*M*	*SD*	*t*	*Df*	Sig (2 tailed)	Decision
Experimental	43	3.85	0.17	-2.58	82	0.01	S
Control	41	3.65	0.46				

p<0.05

Table 4: t-test Analysis of the Attitude Scores of Students in Experimental and Control Groups

RESEARCH QUESTION 2

What difference exists in the pre-attitude and post-attitude level scores among students that learn physics using jigsaw instructional strategy?

Table 5 showed the attitude level scores of students in the experimental group before and after exposure to jigsaw instructional strategy. There were 43 students in the experimental group out of which 2% had high positive attitude, 40% had moderate positive attitude, 53% had low positive attitude and 2% had low negative attitude towards physics before treatment (JIS). After the treatment, 2% had high positive attitude, 86% had moderate positive attitude and 12% had low positive attitude towards physics. Students did not exhibit any negative attitude towards physics after learning physics using jigsaw instructional strategy.

Attitude Levels	Mean Attitude Score Interval	Pre-attitude		Post-attitude	
		f	%	*f*	%
High negative	1.00 – 1.66	0	0	0	0
Moderate negative	1.67 – 2.33	0	0	0	0
Low negative	2.34 – 2.99	2	5	0	0
Low positive	3.00 – 3.66	23	53	5	12
Moderate positive	3.67 – 4.33	17	40	37	86
High positive	4.34 – 5.00	1	2	1	2
		43	100	43	100

Table 5: Mean Pre-attitude and Post-attitude Level Scores of Students in the Experimental Group

HYPOTHESIS 2

There is no significant difference in the pre-attitude and post-attitude scores among students that learn physics using jigsaw instructional strategy.

The result in Table 6 showed the pre-attitude and post-attitude scores of students in the experimental group. A calculated t-value of -5.50 was computed with a degree of freedom (1, 42) at 0.05 significance level. Since the p-value of 0.01 was less than the alpha value of 0.05, hypothesis 2 was rejected. There was therefore, a significant difference in the pre-attitude (M = 3.61, SD = 0.36) and post-attitude (M = 3.85,

SD = 0.17) scores of students that learn physics using jigsaw instructional strategy. This implies that students developed more positive attitude after learning physics with jigsaw instructional strategy (t (42) = -5.50; p<0.05).

Group	*N*	*M*	*SD*	*t*	*Df*	Sig (2 tailed)	Decision
Pre-attitude	43	3.61	0.39	-5.50	42	0.01	S
Post-attitude	43	3.85	0.17				

p<0.05

Table 6: Paired t-test Analysis of Pre-attitude and Post-attitude Scores of Students in the Experimental Group

RESEARCH QUESTION 3

How do the attitude scores among students differ when they learn physics using jigsaw instructional strategy based on gender?

Table 7 showed that the mean attitude scores of male and female students in the experimental group were 3.88 and 3.81 respectively. The mean difference of 0.07 was negligible. This means that students in the experimental group had similar attitude based on gender.

Gender	*N*	*M*	*SD*	Mean difference
Male	22	3.88	0.17	0.07
Female	21	3.81	0.20	
Total	43			

Table 7: Mean Attitude Scores of Students in the Experimental Group based on Gender

HYPOTHESIS 3

There is no significant difference in the mean attitude scores among students that learn physics using jigsaw instructional strategy based on gender.

The analysis in Table 8, revealed the attitude scores of male and female students in the experimental group. The calculated t-value of 1.27 with degree of freedom (1, 41) was computed at 0.05 critical levels. Since the calculated significance 0.21 was greater than the critical significance 0.05, hypothesis three was not rejected. This suggests that there was no significant difference in the mean attitude scores of male (M=3.88, SD=0.17) and female (M=3.81, SD=0.20) students that learn physics using jigsaw instructional strategy (t (41) = 1.27; p>0.05).

Gender	*N*	*M*	*SD*	*t*	*df*	Sig (2 tailed)	Decision
Male	22	3.88	0.17	1.27	41	0.21	NS
Female	21	3.81	0.20				

p>0.05

Table 8: t-test Analysis of the Mean Attitude Scores of Students in the Experimental Group based on Gender

RESEARCH QUESTION 4

Is there any difference between the mean attitude scores among students that learn physics using jigsaw instructional strategy based on score level?

Table 9 revealed that the mean attitude scores of high, medium and low scoring students that learn physics using jigsaw instructional strategy were 3.81, 3.91 and 3.77 respectively. The mean difference between high and medium scoring students was 0.10 while the mean difference between medium and low scoring students was 0.14. Also the mean difference between high and low scoring students was 0.04. These mean differences were negligible. This means that students in the three scoring levels had similar attitude after learning physics with jigsaw instructional strategy.

Scoring level	*N*	*M*	*SD*
High	10	3.81	5.63
Medium	21	3.91	4.64
Low	12	3.77	5.88
Total	43		

Table 9: Mean Attitude Scores of Students in the Experimental Group based on Score Level

HYPOTHESIS 4

There is no significant difference in the mean attitude scores among students that learn physics using jigsaw instructional strategy based on score level.

The analysis in Table 10, revealed the one-way between-groups analysis of variance on the attitude scores of high, medium and low scoring students. There was no significant difference at the p>0.05 level in the post-attitude scores for high, medium and low scoring students that learnt physics using jigsaw instructional strategy: F (2, 40) = 0.25, p = 0.78. The null hypothesis was therefore not rejected. This means that high (M = 3.81, SD = 5.63), medium (M = 3.91, SD = 4.64) and low (M = 3.77, SD = 5.88) scoring students had similar attitude scores after learning physics with jigsaw instructional strategy.

Scoring Level	Sum of Squares	*Df*	Mean Square	*F*	Sig.
Between Groups	0.18	2	0.09	3.06	0.06
Within Groups	1.14	40	0.03		
Total	1.32	42			

p > 0.05

Table 10: One-way ANOVA Analysis of the Mean Attitude Scores of Students in the Experimental Group based on Score Level

VI. DISCUSSION OF FINDINGS

The findings of the study showed that jigsaw instructional strategy (JIS) produced positive changes in students' attitude levels towards physics. This implies that JIS can be used to bring about changes from negative to positive attitude levels,

and from low attitude levels to moderate and high attitude levels in students. This finding corresponds with the findings of Akinbobola (2009); Akinbobola and Ikitde (2010); Abdul, Muhammad and Manzoor (2011); and Akinbobola (2015); who reported that active instructional strategies produced changes from negative to positive attitudes of students' towards physics. This finding is contrary to that of Sengul and Katranci (2014), who concluded that jigsaw technique had no effect on changing students' attitude positively towards mathematics. The result of the study also revealed that students had positive change in attitude towards physics based on gender after exposure to jigsaw instructional strategy. This implies that jigsaw instructional strategy can be used to bring about positive change in students' attitude towards physics irrespective of gender. The study also indicated that JIS produced changes in the attitudes of low, medium and high scoring students from negative to positive; and from low levels to moderate and high levels. This also implies that JIS can be used in changing students' attitude from negative to positive levels.

VII. CONCLUSION

The study investigated the effectiveness of jigsaw instructional strategy on senior school students' attitude towards physics. The study showed that the use of JIS changed students' attitude from negative to positive levels and from low positive levels to moderate and high positive levels. The study also concluded that gender and score levels did not have influence on the attitude of students that learnt physics using JIS.

VIII. RECOMMENDATION

Based on the findings of this study, the following recommendations were considered;

- ✓ JIS is an effective instructional strategy; it should therefore be used to encourage and improve the teaching and learning of physics in senior secondary schools.
- ✓ The use of JIS should be used to improve students' attitude towards physics and encourage students to do more research on physics topics.
- ✓ Professional bodies like National Teachers' Institute (NTI), Science Teachers' Association of Nigeria (STAN), and Mathematics Association of Nigeria (MAN) should organize seminars and workshops for teachers on how to use jigsaw instructional strategy for effective teaching and learning process.

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