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Jigsaw iv Cooperative Learning Strategy and Students' Motivation Towards Senior Secondary Physics in Jos Metropolis, Nigeria

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Abstract

The study investigated Jigsaw iv cooperative learning strategy (J4CLS) and students' motivation towards senior secondary Physics in Jos metropolis, Nigeria. It employed the non-equivalent control group pretest-posttest type of quasi-experimental research design. One hundred and forty-five (145) senior secondary two (SS II) students from four co-educational secondary schools were used as sample for the study. A 35-item Likert scale instrument called Students' Motivation toward Learning Physics Questionnaire (SMoTLPQ), whose reliability coefficient was computed as 0.72 using Cronbach's coefficient alpha method on the Statistical Package for Social Sciences (SPSS) Software Version 25, was used to elicit information. Three research questions were raised and answered using mean while four hypotheses were formulated and tested at $\alpha = 0.05$ using Analysis of Covariance (ANCOVA). Findings revealed, amongst others, that students taught using J4CLSachieve significantly higher than students instructed under conventional lecture method (CLM), irrespective of gender and the type of school they attend. Based on the findings, recommendations were made which include encouraging Physics teachers to employ J4CLSin teaching secondary school students, since the method has been found to improve students' motivation toward learning Physics and it is gender-friendly and independent of school type in terms of improving their motivation.

Keywords: *Jigsaw IV cooperative learning strategy (J4 CLS), Physics, Students' gender, Students' motivation, School type, Jos's metropolis, Nigeria*

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Background to the Study

The core science subjects in the Senior Secondary School (SSS) curriculum in Nigeria are Biology, Chemistry and Physics. While Biology is a biological science which deals with animate matter, Physics and Chemistry are physical sciences which deal with the properties and behaviour of inanimate matter. Specifically, Physics deals mainly with inanimate matter in relation to energy. Josiah (2020) was of the view that students at the SSS level of education acquire knowledge of these core science subjects which provide them with the foundation for further studies in science and science-related courses at the tertiary level.

The Nigerian Educational Research and Development Council [NERDC], (2008) opined that Physics is a subject which 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 useful to man in all facets of life through its principles, laws and theories. For instance, it is in the electric light that is switched on, the car that is driven, the wrist-watch that is strapped on, the cell phone, radio and television set. It is in the equipment used for diagnosing diseases in patients, be it out-patients or 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 underpins the understanding of other fields will result to a gradual decline in the understanding of such fields as agriculture, engineering, medicine and telecommunication (Josiah, 2020). The 21st century world is focusing on student-centred strategies to facilitate the study of Physics in schools. This is because teacher-centred methods of teaching do not seem to promote the much-required critical thinking and problem-solving skills in students which lead to improved achievement. In contrast, student-centred methods offer opportunities to students for practically learning to learn, communicating effectively and being proficient in understanding concepts. One of such student-centred methods that have this advantage it the cooperative learning method.

Cooperative learning method is an instructional method in which small groups of students work on a common assignment together so as to achieve specific objectives of that assignment. There are several possible ways that can be used to place students in cooperative groups. MacPherson (2000, provided those ways as randomly-assigned groups, topic-related groups, geographic groups, social integration groups, self-formed groups and teacher-assigned groups. There are many strategies of cooperative learning method such as round robin brainstorming and jigsaw cooperative learning strategy. This study focused on jigsaw cooperative learning strategy, specifically the jigsaw iv cooperative learning strategy (J4CLS) which employed the teacher-assigned grouping. In the teacher-assigned grouping, the teacher assigns learners to groups to ensure that the groups are heterogeneous in terms of academic ability, ethnic background, gender and any other factors that may be relevant. The teacher ensures that best friends and worst enemies are not placed in the same group. If they are, communication patterns in the group will not be as effective.

The J4CLS utilizes Jigsaw activities and aims at reducing learning conflict and enhancing positive educational outcomes. Students in a class are first organized into 'jigsaw' groups, also called 'home' groups and are assigned portions of a task to accomplish. The students in the

jigsaw groups are then re-organized into 'expert' groups containing one student from each jigsaw group, having same portion of the task to be accomplished. After learning the assignment, each student goes back to his/her original jigsaw group to contribute. This method of teaching can be used to teach students in both theory and practical aspects of Physics.

Although the world is embracing student-centred methods, the conventional lecture method of teaching (CLM) is still the most frequently employed method of teaching Physics in Nigerian secondary schools (Josiah, Usman, Mallo, Gwamna and Inyang, 2020), and has been identified by Boyo (2010), Thomas and Israel (2013) to be ineffective and the least performing method. The CLM was defined by Ojediran, Oludipe and Ehindero (2014) as a one-way traffic process of teaching and learning with the teacher being active and the students being passive, mere listeners and note-writers. This method of teaching merely involves very little inductive thinking, the reasoning being almost completely deductive. This is because the students are simply passive listeners during the transfer of information by the teacher. Moreover, students taught under CLM find learning boring causing them to lose motivation towards learning the concept or subject being taught. Results of students in Senior School Certificate Examinations (SSCE) in Physics, organized by West African Examinations Council (WAEC) and National Examinations Council (NECO), have suggested that the CLM used by teachers in teaching Physics in Nigeria may be ineffective and not motivating.

Motivation is an important component of learning in the school environment, as it affects students' willingness and desire to study. It may also directly affect their achievement in the subject they are learning. Factors such as interest in a subject lead to students' intrinsic motivation to learn the subject; and a student that is motivated to learn achieves high in what he/she learns. This motivation to learn can be achieved in the students through the use of teaching methods that actively engage students in the teaching-learning process. Changeiywo, Wambugu and Wachanga (2011), opined that the teaching method a teacher employs is a strong factor that may affect students' motivation towards learning a subject, thereby affecting their achievement in the subject. Students' motivation constructs include self-concept, self-efficacy, perceptions of learning value, use of learning strategies, learning goal orientations and perceptions of the learning environment. In a typical classroom setting, there are male and female students who participate actively in the learning process. It is important that both male and female students are motivated to learn Physics.

This work was anchored on Cognitive Evaluation Theory of motivation propounded by Deci and Ryan in 1985. The choice of this theory was because any meaningful learning should involve the learner's motivation which leads to competency and self-determination; moreover, the learner is expected to socially relate with classmates. Cognitive Evaluation Theory of motivation (CET) opines that environment and social-context lead to feelings of competence in the learner which, in turn, have a positive effect on intrinsic motivation. In addition, intrinsic motivation is positively impacted when learners feel competent and self-determined (autonomous); furthermore, when learners engage in activities for internal rather than external reasons (locus of causality), there will be a positive effect on intrinsic motivation. The

principles of CET apply only to activities that hold intrinsic interest, because the activities will be experienced as intrinsically motivated. CET suggests that there are actually two motivation systems, intrinsic and extrinsic, that corresponds to two kinds of motivators: intrinsic motivators that come from the actual performance of a task by a learner (the intrinsic interest of the task), such as achievement, responsibility and competence, and extrinsic motivators that come from a learner's environment (controlled by others), such as external rewarding and/or punishment.

The theory holds the view that one or the other of these motivators may be a more powerful motivator for a given learner; and that intrinsically motivated learners perform for their own achievements and satisfaction. If they come to believe that they are doing some tasks because of the reward or some other extrinsic reason, they begin to lose intrinsic motivation. The J4CLS is a suitable method of teaching associated with CET. This is because students in J4CLS interact with one another (social interaction), thereby sharing their personal experiences on a given Physics task. They also evaluate the workability of J4CLS; when they are able to evaluate and get the correct answers to given tasks, it motivates them towards learning Physics concepts. Moreover, the strategy improves such students' motivation, subsequently lowering frustration and anxiety among students when they use it to learn concepts.

Gender issues are of global contemporary concern and gender disparities have been found in students' motivation towards learning. For example, a study by Lynch and Trujillo (2011) showed that female students display less active motivation in the sciences and in mathematics than their male counterparts. However, in contrast, Joshi and Srivastava (2009), had earlier found out that female students are more highly motivated to learn Physics than the male students. Other studies such as those embarked upon by Changeiywo, et al (2011), Saleh (2014), Josiah and Mankilik (2018,) found no significant differences in the effect of gender on students' motivation towards learning Physics in school.

School type is another moderating variable which may affect students' motivation in Physics. School type refers to the categorization of secondary schools into public and private schools. While public schools are the type of schools owned by Government (Local, State or Federal), private schools are the type owned by individuals, group of individuals, communities or religious bodies. Private schools vary widely and levels of involvement of parents vary from one private school to the other. What seems important for a parent is to choose a private school that has characteristics that match what they are looking for as a family. Parents pay highly for the cost of educating their children in private schools and therefore tend to be more involved in dictating what the schools offer than parents whose children are attending public schools (Olatoye and Agbatogun, 2009).

Although studies such as those of Tran and Lewis (2012), Sengul and Katranci (2014), Timayi, Bolaji and Kajuru (2015), Josiah and Mankilik (2018) were conducted on jigsaw cooperative learning strategy, none of such studies, to the best of the knowledge of the researcher, seemed to have been conducted on students' motivation in Jos's metropolis,

Nigeria. Operationally defined, the term Jos metropolis refers to Jos North Local Government Area of Plateau State, Nigeria comprising the fourteen wards delineated by the Independent National Electoral Commission (INEC). These wards are: Naraguta A, Naraguta B, Tudun Wada/Kabong, Vanderpuye, Gangare, Abbah-Na-Shehu, Ali Kazaure, Jos Jarawa, Ibrahim Katsina, Jenta, Garba Daho, Sarkin Arab, Tafawa Balewa and Dalhatu (Josiah and Mankilik, 2018). Moreover, such studies did not consider the effect of school type (public and private) on students' motivation in Physics except that of Josiah and Mankilik (2018).

This study was, therefore, conducted to determine if the use of J4CLSin co-educational public and private secondary schools in Jos metropolis, Nigeria would achieve the following specific objectives determine the pre-test and post-test mean motivation scores of secondary school students exposed to jigsaw iv cooperative learning strategy (J4CLS) and conventional lecture method (CLM); ascertain the pre-test and post-test mean motivation scores of male and female secondary school students exposed to J4CLS; find out the extent to which school type influences the motivation of secondary school students towards Physics when exposed to J4CLS; determine the effect of J4CLSon secondary school students' motivation towards learning Physics; ascertain the effect of gender on secondary school students' motivation towards learning Physics, after being taught using J4CLS; determine the effect of school type on the motivation of secondary school students toward learning Physics after being taught using J4CLS; and find out the interaction effect of treatment and gender on secondary school students' motivation towards learning Physics.

Statement of the Problem

Despite the importance of Physics to national development, the situation of students' achievement in Physics examinations in Nigeria such as Senior School Certificate Examination (SSCE) organized by West Africa Examinations Council (WAEC) and National Examinations Council (NECO) has been unsatisfactory and fluctuating. This persistent fluctuation and not too impressive outcome have also been attributed to the lack of motivation that the ineffective methods of teaching Physics, such as the conventional lecture method, employed by teachers in the classroom present to students, among others (NECO, 2011, 2012; WAEC, 2015). Researches such as those of Boyo (2010), Josiah, Mallo and Inyang (2019), Josiah and Emmanuel (2020) indicated that the lecture method of teaching, which is not student-centred, is ineffective and seems not to motivate students towards learning physics, is still being employed in the Physics classroom in Nigeria. If students are less motivated to learn physics, there may be gradual and subsequent decline in the understanding of Physics which may affect other Physics-related fields such as medicine, agriculture and engineering leading to decline in the socio-economy of the nation. The study, therefore, sought to investigate the effect of J4CLS on students' motivation toward learning secondary school Physics in Jos metropolis, Nigeria.

Research Questions

The following research questions were raised for the study:

1. What are the pre-test and post-test mean motivation scores of senior secondary two (SS II) students exposed to Physics using jigsaw iv cooperative learning strategy (J4CLS) and conventional lecture method (CLM)?

2. What are the pre-test and post-test mean motivation scores of male and female SS II students exposed to Physics using J4CLS?
3. To what extent does school type influence the motivation of SS II students exposed to Physics usingJ4CLS?

Hypotheses

The following null hypotheses were formulated and tested at 0.05 levels of significance:

1. There is no significant effect of J4CLSon senior secondary two (SS II) students' motivation towards learning Physics.
2. There is no significant effect of gender on SS II students' motivation towards learning Physics, after being taught using J4CLS.
3. There is no significant effect of school type on motivation of SS II students toward learning Physics after being taught using J4CLS.
4. There is no significant interaction effect of treatment and gender on SS II students' motivation towards learning Physics.

Methodology

The study adopted the quasi-experimental research design of the non-equivalent control group pre-test, post-test type because intact classes, instead of subject randomization, were used. The simple random sampling technique using the Table of Random Digits (two-digit column) was used to obtain the four sampled co-educational secondary schools (two public and two private) for the study. One of the two public schools was randomly assigned to experimental group while the second was assigned to the control group. In the same vein, one of the two private schools was randomly assigned to experimental group while the second was assigned to the control group. An intact sample of a total of 145senior secondary two (SS II) students (78 male and 67 female) offering Physics from the four sampled co-educational secondary schools (two from 22 co-educational public schools and two from 143 co-educational private schools) was used for gathering data for the study. The experimental group had 44 males and 38 females, while 34 males and 29 females were in the control group.

The instrument used in the study was a 35-item Likert scale Students' Motivation Toward Learning Physics Questionnaire (SMoTLPQ) whose reliability coefficient was computed as 0.72 using Cronbach's coefficient alpha method on the Statistical Package for Social Sciences (SPSS) Software Version 25. The SMoTLPQ was adapted and modified from Tuan, Chin and Shieh's (2005) motivation instrument named Students' Motivation Toward Science Learning (SMTSL). This enabled the researcher to measure students' motivation toward learning Physics. The instrument was initially given to three experts in the University of Jos for face, content and construct validity.

Prior to treatment on the experimental group, the SMoTLPQ was administered as pre-test to the entire sample in the two groups. This administration was done a week before starting the treatment. The pre-test was carried out so as to determine the direction of motivation of students towards learning Physics before treatment. Thereafter, treatment was carried out on the experimental group for a period of four weeks on the topic heat energy measurements. The

control group was merely engaged on the same topic heat energy measurements by being taught using CLM during the same period of four weeks that the experimental group was treated. After the four weeks treatment, in the fifth week, the SMoTLPQ was administered as post-test to all the students in both the experimental and control groups. The post-test was administered so as to determine whether the experimental and control groups differ in their mean scores of motivations towards concepts of heat energy measurements. The mean and standard deviation (descriptive statistics) were used to answer all the three research questions that were raised; while Analysis of Covariance (ANCOVA) was employed to test all the four formulated hypotheses.

Results

Research Question One

What are the pre-test and post-test mean motivation scores of senior secondary two (SS II) students exposed to Physics using jigsaw iv cooperative learning strategy (J4CLS) and conventional lecture method (CLM)?

Table 1 shows a summary of the pre-test and post-test mean motivation scores of SS II students exposed to Physics usingJ4CLS and CLM. It is the summary of the data analysis on research question one.

Table 1: Pre-test and Post-test Mean Motivation Scores of SS II Students Exposed to Physics using J4CLS and CLM

Group		Pre-test		Post-test	
	N	$\overline{X}$	SD	$\overline{X}$	SD
Experimental	82	116.56	12.43	129.60	12.94
Control	63	113.54	14.73	112.76	15.09

Table 1 reveals that the pre-test and post-test mean motivation scores of SS II students exposed to J4CLSwere 116.56 and 129.60, respectively. However, the pre-test and post-test mean motivation scores of SS II students exposed to CLM were 113.54 and 112.76, respectively. When compared to the pre-test mean motivation scores, students in the experimental group had a higher motivation mean score (positive motivation) after exposure J4CLS; while those in the control group who were taught Physics using the CLM had a lower motivation mean score (negative motivation).

Research Question Two

What are the pre-test and post-test mean motivation scores of male and female SS II students exposed to Physics using J4CLS?

The summary of data analysis on research question two, which addressed the pre-test and post-test mean motivation scores of male and female SS II students exposed to Physics using J4CLS, is provided in Table 2.

Table 2: Pre-test and Post-test Mean Motivation Scores of SSII Male and Female Students Exposure to J4CLS

Group	Gender		Pre-test		Post-test	
		N	$\overline{X}$	SD	$\overline{X}$	SD
Experimental	Male	44	121.25	11.08	130.05	11.92
	Female	38	120.21	11.54	127.61	13.89

The findings in table 2 reveal that male students in the experiment group had a marginally lower motivation mean score of 121.25 before treatment than the motivation mean score of 130.05 after the treatment, while their female counterparts had respective pre-test and post-test motivation mean scores of 120.21 and 127.61. This implies that the motivation toward learning Physics of both male and female students in the experimental group slightly improved (positive motivation) after the administration of treatment on them using the J4CLS**.**

Research Question Three

To what extent does school type influence the motivation of SS II students exposed to Physics using J4CLS?

Tables 3 presents the results of data analyses on research question three which addressed the influence of school type on motivation of secondary school students towards learning Physics in Jos metropolis, Nigeria. It indicates the summary of the extent to which school type influenced SS II students' motivation after exposure to Physics usingJ4CLS.

Table 3: Pre-test and Post-test Mean Motivation Scores of SS II Public and Private School Students Exposed to Physics using J4CLS

School Type		Pre-test		Post-test	
	N	$\overline{X}$	SD	$\overline{X}$	SD
Private	42	108.59	11.59	123.54	14.74
Public	40	98.26	12.75	121.45	14.98

Table 3 shows that the pre-test means motivation score of SS II Physics students in private schools exposed to J4CLS was 108.59, while their post-test mean motivation score was 123.54. Furthermore, public secondary school students exposed to treatment of teaching using JCL strategy had respective pre-test and post-test mean motivation scores of 98.26 and 121.45. Findings from the study further reveal that the students' motivation to learn Physics in both private and public secondary schools was enhanced to some extent (with respective mean differences of 14.95 and 23.19 for public and private schools). This could be attributed to the exposure of the students in the experimental groups to the treatment of teaching using the J4CLS. This implies further that the J4CLScan motivate students towards learning Physics when teachers use it in teaching Physics concepts.

Hypothesis One
There is no significant effect of J4CLS on senior secondary two (SS II) students' motivation towards learning Physics.

Table 4 provides summary of Analysis of Covariance (ANCOVA) results of effect of J4CLS on SS II students' motivation towards learning Physics. It summarizes the data analysis on hypothesis one.

Table 4: ANCOVA Results of Effect of J4CLS on SS II Students' Motivation towards Learning Physics

Source	Type III Sum of Squares	Df.	Mean Square	F	P
Corrected Model	12414.417[a]	3	4.806	16.134	.011
Intercept	43.719	1	43.719	55.804	.000
Pretest	241.198	1	41.198	1.529	.220
Group	239.164	2	88.164	11.697	.001
Error	1461.108	142	.783		
Total	14399.606	145			
Corrected Total	12938.498	144			

R Squared = .691 (Adjusted R Squared = .660)

The results in table 4 reveal that F (3,142 = 16.134, p=.011). That is $p<0.05$. This means that H_o was rejected and conclusion was drawn that there was a significant effect of J4CLS on SSII students' motivation toward learning Physics. However, the result from the covariate (Pretest motivation scores) reveals a p-value of .220. This implies that $p>0.05$ which means that there was no significant effect of method of teaching (CLM) on students' motivation toward learning Physics before they were exposed to treatment of teaching using J4CLS. This also implies that students' motivation toward learning Physics before treatment was not significant since $p>0.05$ ($0.220>0.05$). However, since $p<0.05$ for the group, it means that a significant effect existed and this was attributed largely due to the treatment administered to students in the experimental group. The adjusted R square of .660 implies that 66.0 percent of the changes in students' motivation in the group was due to or explained by changes in the treatment, which was teaching using J4CLS; the remaining was due to other factors captured as error. The implication of this also is that the J4CLScan motivate students to learn Physics as a subject if Physics teachers use it in their teaching.

Hypothesis Two
There is no significant effect of gender on SS II students' motivation towards learning Physics, after being taught using J4CLS.

Table 5 shows ANCOVA results of effect of gender on SS II students' motivation towards learning Physics, after being taught using J4CLS. It provides the summary of the data analysis performed on hypothesis two.

Table 5: ANCOVA Results of Effect of Gender on Students' Motivation toward Learning Physics After Exposure to J4CLS

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	13427.927[a]	3	9.309	14.821	.084
Intercept	1289.696	1	89.696	1.109	.001
Before	379.046	1	79.046	.073	.788
Gender	262.043	1	93.043	19.174	.069
Error	1337.057	142	.628		
Total	16695.769	145			
Corrected Total	15387.712	144			

R Squared = .430 (Adjusted R Squared = .401)

Table 5 results showed that F (3,145=14.821, p =0.084). That is p>0.05, which implies that H_o failed to be rejected. Based on this result, inference was drawn that there was no significant effect of gender on SSII Physics students' motivation toward learning Physics after exposure to J4CLS. That is, since the probability value for gender alone (p=0.069) was greater than 0.05(p>0.05), it implied that gender had no significant effect on students' motivation towards learning Physics when exposed to J4CLS. The value of adjusted R squared, computed as .401, means that only 40.1 percent of the changes in students' motivation towards learning Physics was explained by gender; greater part of the variation that is 59.9 percent, was due to other factors captured as error in this model. Furthermore, p = 0.788 implies that motivation before treatment was insignificant.

Hypothesis Three

There is no significant effect of school type on motivation of SS II students toward learning Physics after being taught using J4CLS.

Table 6 shows ANCOVA results of interaction effect of school type on SS II students' motivation, after being taught using J4CLS. It is the results of the data analysis on hypothesis three.

Table 6: ANCOVA Results of Effect of School Type on Students' Motivation toward Learning Physics After Exposure to J4CLS

Source	Type III Sum of Squares	Df	Mean Square	F	P
Corrected Model	33545.122[a]	3	1.707	15.892	.058
Intercept	1210.944	1	1210.944	37.767	.070
Before	59.204	1	99.204	.705	.537
School Type	171.135	1	171.135	3.916	.056
Error	1129.852	142	.290		
Total	36680.400	145			
Corrected Total	35550.548	144			

R Squared = .342 (Adjusted R Squared = .314)

Table 6 results show that F (3,145=15.892, p =0.058). That is p>0.05, which implies that H_o failed to be rejected. Based on this result, inference was drawn that there was no significant effect of school type on SSII Physics students' motivation toward learning Physics after exposure to J4CLS. That is, since the p-value for school type alone (p=0.056) was greater than 0.05(p>0.05), it implied that school type had no significant effect on students' motivation towards learning Physics when exposed to J4CLS. The value of adjusted R squared, computed as .314, means that school type explained only 31.4 percent of the changes in students' motivation towards learning Physics; greater part of the variation that is 68.6 percent, was due to other factors captured as error in this model. Furthermore, p = 0.537 implies that motivation before treatment was not significant.

Hypothesis Four

There is no significant interaction effect of treatment and gender on SS II students' motivation towards learning Physics.

Table 7 provides the ANCOVA results of interaction effect of treatment and gender on SS II students' motivation towards learning Physics. It is the results of the data analysis performed on hypothesis four.

Table 7: ANCOVA Results of Interaction Effect of Treatment (J4CLS) and Gender on Students' Motivation towards Physics

Source	Type III Sum of Squares	Df	Mean Square	F	P
Corrected Model	21974.987[a]	3	24.996	39.621	.015
Intercept	2123.071	1	2123.071	4.868	.230
Treatment	172.322	1	172.322	.511	.037
Gender	84.314	1	74.384	22.690	.395
Treatment*Gender	177.535	2	67.523	27.795	.010
Error	2849.208	142	.631		
Total	27381.437	145			
Corrected Total	24532.229	144			

R Squared = .864 (Adjusted R Squared = .859)

The results from table 7 indicates that F (3,142 = 39.621, p =.015). That is p<0.05, which implies that H_o was rejected and inference drawn that there was a significant interaction effect of treatment and gender on SSII students' motivation toward learning Physics after exposure to J4CLS. The results show that treatment alone had a p-value of 0.037 which implies that it had significant interaction effect on students' motivation towards learning Physics. However, the findings further reveal that gender alone with p>0.05 had no significant interaction effect on students' motivation towards learning Physics since its p-value was 0.395. The adjusted R square value of .859 means that 85.9 percent of the changes in students' motivation toward learning Physics were explained by treatment and gender, while the rest were captured in the model as error.

Discussion

The results from research question one, presented in table 1, reveal that SSII students offering Physics in the experimental group who were exposed to J4CLSwere positively motivated, while those in the control group who were taught Physics using the CLM were negatively motivated. This finding is in line with Azmin's (2016). finding that students taught with jigsaw cooperative learning strategy are positively motivated to learn. Hypothesis one was formulated to find out if J4CLS had a significant effect on students' motivation towards learning Physics. The results from hypothesis one, presented in Table 4, revealed that H_o was rejected and conclusion drawn that there was a significant effect of J4CLS on SSII students' motivation toward learning Physics. However, the result from the covariate (Pretest motivation scores) revealed a p-value of .220. This implies that $p>0.05$, which means that there was no significant effect of method of teaching (CLM) on students' motivation toward learning Physics before they were exposed to treatment of teaching using theJ4CLS. This also implies that students' motivation toward learning Physics before treatment was not significant since $p>0.05$ ($0.220>0.05$). However, since $p<0.05$ for the group after treatment, it means that a significant effect existed and this was largely attributed to the treatment administered to students in the experimental group. The adjusted R square of .660 implies that 66.0 percent of the changes in students' motivation in the group was due to or explained by changes in the treatment, which was teaching using J4CLS; the remaining 34.0 percent of the changes was due to other factors captured as error. The implication of this also is that J4CLScould motivate students to learn Physics as a subject if Physics teachers use it in their teaching. This finding is in consonance with Hanze and Berger (2007), Josiah and Mankilik's (2018), findings that students taught using jigsaw cooperative learning strategy are significantly motivated by the strategy.

The results from research question two as presented in Table 2 show that both male and female students in the experimental group had marginally lower pre-test mean motivation scores than their respective post-test mean motivation scores. The implication is that both male and female students in the experimental group slightly improved positively in their motivation toward learning Physics after the administration of treatment using the J4CLS. This finding is in consonance with Sheikhi, Zainalipoor and Jamri (2012), Josiah and Mankilik (2018) who found out that students subjected to learning using jigsaw cooperative learning strategy are positively motivated, irrespective of their gender. Hypothesis two was formulated to ascertain whether students' gender had any significant effect on their motivation towards learning Physics when students are taught usingJ4CLS. The results from that hypothesis, presented in Table 5, showed that H_o failed to be rejected. Based on this result, inference was drawn that there was no significant effect of gender on SSII Physics students' motivation toward learning Physics after exposure to J4CLS. That is, since the probability value for gender alone ($p=0.069$) is greater than $0.05(p>0.05)$, it connotes that gender has no significant effect on students' motivation towards learning Physics when the students are exposed to J4CLS. The value of adjusted R squared, computed as .401, means that only 40.1 percent of the changes in students' motivation towards learning Physics were explained by gender; greater part of the variation, which is 59.9 percent, was due to other factors captured as error in this model. Furthermore, $p =0.788$ implies that motivation before treatment was insignificant. The

finding of this study concurs with that of Sheikhi, Zainalipoor and Jamri (2012) that jigsaw cooperative learning strategy increases the motivation of both male and female students who are exposed to learning using the strategy and is gender-insensitive.

Hypothesis four was formulated to ascertain whether both treatment and gender had any significant interaction effect on students' motivation towards learning Physics. The results of hypothesis four, presented in Table 7, indicates that H_o was rejected and inference drawn that there is a significant interaction effect of treatment and gender on SSII students' motivation toward learning Physics after exposure to J4CLS. The results show that treatment alone had a p-value of 0.037 which implies that the strategy has significant interaction effect on students' motivation towards learning Physics. However, the findings further revealed that gender alone with $p>0.05$ has no significant interaction effect on students' motivation towards learning Physics, since its p-value was 0.395. The adjusted R square value of .859 means that 85.9 percent of the changes in students' motivation toward learning Physics was explained by treatment and gender, while the rest was captured in the model as error. This finding that gender alone has no significant interaction effect on students' motivation towards learning Physics agrees with those of Changeiywo, et. al. (2011), Okoronka and Wada (2014), Saleh (2014), Josiah and Mankilik (2018) that gender has no significant effect on students' motivation toward learning.

The results of research question three, presented in Table 3, shows that students from both private and public schools that are exposed to J4CLSare positively motivated. Hypothesis three was formulated to determine if there was a significant effect of school type on motivation of SS II students toward learning Physics after being taught using J4CLS. Results of hypothesis three from table 6 shows that H_o failed to be rejected. Inference is, therefore, drawn that there is no significant effect of school type on students' motivation toward learning Physics after exposure to J4CLS. That is, since the p-value for school type alone ($p=0.056$) is greater than 0.05($p>0.05$), school type has no significant effect on students' motivation towards learning Physics when exposed to J4CLS. This finding is in agreement with that of Ritho (2015), that the type of school attended by students has no effect on their intrinsic motivation toward learning. The finding from this research question could, therefore, be attributed to the exposure of the students, in the experimental group from both school types, to the treatment of teaching using the J4CLS. This implies further that J4CLScan motivate students towards learning Physics when teachers use it in teaching Physics concepts.

Recommendations

Based on the findings of this study, the following recommendations have been made:

1. Teachers of Physics should be encouraged to use J4CLS in teaching secondary schools Physics, since it has been found to motivate students towards learning.
2. NERDC and Science Teachers Association of Nigeria (STAN) should be encouraged to use J4CLS, as a strategy of teaching Physics, in planning and developing secondary school Physics curriculum. They should also be encouraged to incorporate this strategy in the publication of textbooks.

3. Ministries of Education in Nigeria should be encouraged to formulate policies to make J4CLSa teaching strategy in secondary schools. This is because the strategy has been found to motivate students towards learning. It has also been found to increase motivation, without discrimination to students' gender and the type of school they attend.

Conclusion

This study hinged on the premise that the conventional lecture method (CLM) used by teachers to teach Physics in most secondary schools in Nigeria, do not motivate students to learn Physics. After exposure students who were taught with J4CLShad a higher motivation mean score (positive motivation). It was also found out that the male and female students' motivation toward learning improved (positive motivation) when they were taught using J4CLS. Furthermore, the study revealed that the motivation of students that were taught in both private and public secondary schools using J4CLSincreased. The implication of the findings of this study is that J4CLScan motivate students towards learning Physics when teachers use it in teaching Physics concepts. Therefore, for improved motivation, students should be taught Physics concepts using J4CLS.

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