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EFFECTS OF COOPERATIVE LEARNING STRATEGY ON SENIOR SECONDARY TWO STUDENTS' ACHIEVEMENT IN CHEMISTRY IN JEMA'A, LOCAL GOVERNMENT AREA, KADUNA STATE

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ABSTRACT

The study examined the effects of cooperative learning strategy on senior secondary two students' achievement in Chemistry in Jema'a, Kaduna State. The study had three research questions and three hypotheses formulated in line with the research objectives. Literature was reviewed in line with the research topic, objectives and research questions. The study adopted the quasi experimental research design involving pre-test-post-test nonequivalent control group design. The population of the study consisted of 543 students from public senior secondary schools in Jema'a. The sample of the study was 180 students drawn from four intact classes in senior secondary schools in Jema'a L.G.A. The instrument used for the research was a stoichiometry achievement test (SAT) The validity of the instrument was established by judgment of three experts, one in Research, Measurement and Evaluation Unit of the Department of Educational Foundations, University of Jos. One in Chemistry education unit of the department of science and technology education, University of Jos and a Chemistry teacher at secondary school level. The reliability coefficient of the instrument was determined through administering the research instrument on 30 respondents who were not part of the study. Results were calculated using Kuder Richardson (K-R-20) formula which gives reliability index of 0.70. Data were computed using mean, standard deviation and ANCOVA. The findings of the study showed that Cooperative learning strategy was effective in improving the achievement of secondary school students in Chemistry. The study recommended that Chemistry teachers should adopt the use of cooperative learning instructional strategy in the teaching of Chemistry at the secondary school level. The study further recommended that Special training on the effective implementation of cooperative learning instructional strategy should always be organized for teachers and students by the state government, so as to help them become competent in the use of this teaching strategy in the teaching and learning process.

Key words: cooperative learning, Strategy, Achievement, Stoichiometry

INTRODUCTION .

Science education is an important field of study that plays a vital role in national development. A scientifically literate society enhances rapid economic growth in all sectors, thus promoting national development and national productivity. Chemistry is a branch of science that studies the properties, composition, reactions and uses of matter. Chemistry as a subject taught in secondary schools and universities is divided into many branches which includes; Biochemistry, Organic Chemistry, Inorganic Chemistry, Physical Chemistry, Medical Chemistry, Nuclear Chemistry, and Environmental Chemistry. Chemistry plays a major role in building the scientific base of a country in the sense that it's a prerequisite for higher learning of science based discipline such as Engineering, Medicine, Industrial and Pure Chemistry, Microbiology, Anatomy, Pharmacology, Pharmacy (Ibitoye, 2018). The achievement of Nigerian students in Chemistry at the secondary school level remains a dismal failure despite

the increasing importance of (WAEC Chief Examiner report, 2013-2019). A highlight of the performance of students pass in Chemistry in WAEC examination between 2013 and 2019 is as follows; 72.34%, 62.69%, 60.6%, 57.74%, 62.68%, 61.95%, 40.0%. From the foregoing results in Chemistry, it can be seen that it is only in the year 2013 that the achievement of the students is above 70%. In 2019 the achievement of the students is far below the bench mark. This call into question the strategies used by teacher has not been encouraging. Although, science teachers are making diverse efforts towards adopting new teaching methods that are relevant to the challenges of the time. (Agbo&Amaka, 2020).

Students' low achievement has partly been ascribed to poor teaching methods adopted by teachers (Nghambi, 2014; Jepketer; 2017; Jolif, 2018). For instance, in the delivery of the curriculum content in secondary schools, studies have revealed that secondary school teachers including Chemistry teachers mostly rely on the conventional method that are mainly lectures, and sometimes few demonstrations to convey ideas and facts in the teaching and learning process (King'arru, 2014). In the lecture method, it was observed that, teachers dominated the class during the instruction process by transferring the knowledge with little or without inputs from the students. Students are passively involved, implying they just listen and receive information from their instructors. Indeed, teacher-centred methods limit students' participation, deep understanding of the concept, and creativity, hence seen to be poor in influencing students' achievement as compared to other alternative teaching strategies like Cooperative Learning Strategies, Instructional Technology Strategies, and Inquiry strategies (Chowdhury, 2016). Today, emphasis is now placed on activity base learning strategies which involve the learner active participation in the learning process. Chemistry as a science subject which involved a lot of practical works for students to demonstrate and learn interactively by cooperating with one another in the laboratory should be given attention. Students are provided with the opportunity to collectively and cooperatively perform activities and experiments in the laboratory. Hence in an attempt to improve students' achievement in Chemistry, it is important to transform the teaching approaches. There are several methods used in teaching and learning, these among others are; demonstration method, inquiry method, activity base method, lecture method, cooperative teaching method, guided discovery method, problem solving method, class discussion method, debriefing method, and class action research method. Teaching methods that enable students' subject matter conceptualization and student-student as well as teacher-student interactions could enhance achievement as students can learn from each other's' concepts that they could not learn independently. Such learning approaches are better suited for teaching and learning science concepts including Chemistry. This research work will only focus on the cooperative teaching method (Jiqsaw I).

Cooperative learning strategy is an instructional strategy which deliberates on instructional use of heterogeneous small groups of students who work together to maximize each other's learning. (Igboanuga, 2013). Cooperative learning strategy has been well emphasized as a method that can enhance achievement in chemistry and other related subjects. Cooperative learning has received wide attention among researchers as an educational learning strategy because of its many positive effects on both the teacher and the learner. Cooperative learning is a set of teaching strategies used to promote face to face interaction among students and help them each reach specific learning and inter-personal goals in structured groups (Johnson &Johnson 2014, &Samba, 2014).It has been evidence that student via engaging themselves in promoting interactions and constructive negotiation, tend to achieve more better academically, socially and psychologically than they do in competitive and individualistic modes (Johnson and Johnson, 2013, 2015).

Jigsaw I Cooperative learning requires students to engage in group activities that increase learning and add other important dimensions. (Agbo and Amaka, 2020). Jigsaw I cooperative learning strategy improved race relations and increase personal and social development as the student interact within the groups. Therefore, when jigsaw I cooperative method is used as part of instructional strategy is potent at increasing students' interest, achievement, and knowledge and also has the potentials to enable students engage in reflective thinking (Adodo, 2013). These strategies recognize individual differences in learners and encourage them to create their own knowledge at their own pace.

Achievement is defined as the extent to which an educational goal is attained in terms of scores by a student. Low academic achievement in science has been a source of concern to educators and policy makers. It has attracted the attention of researchers and other educational stakeholders. The persistent low achievement of students in science poses a serious danger to the nation's aspiration of becoming scientifically and technologically great in the near future. One of the serious issues at stake in education today is the question of poor achievement recorded by students in science based courses. Academic achievement according to Nwagbo (2013) is anything a person excelled in with their education. Academic achievement could be getting high grades and a high GPA level. In the context of this study, academic achievement means learning outcome which has to do with the knowledge attain from teaching process, it is also known as achievement. Academic achievement according to Wang and Degot (2016) is the observable and measurable behaviour of a student in a particular situation. Academic achievement of student in chemistry has consistently continued to be poor. This is evident in the WAEC chief examiner reports (2018). In response to the problem of low achievement in secondary school Chemistry, the WAEC Chief Examiner's report recommended the use of effective teaching method which is in tune with the modern science and technological dispensation as the only remedy to students' low achievement in Chemistry (WAEC Chief Examiner report, 2018). Hence, cooperative learning strategy is used to see if it could enhance students' achievement in Chemistry.

Gender refers to the personal sexual identity of an individual, regardless of the person's biological and outward sex (Ibitoye, 2018). Gender can also be seen as a socially ascribed attribute which differentiates male from female. (Mbonu and Okoli 2019). Review of studies show inconsistency on the results of male and female students' academic achievement in Chemistry and science at large. Alamri (2018) found that female students performed better than the male students. Nwachukwu (2014) and Amedu (2015) revealed that boys perform better than their female counterparts. While Kingdom-Aaron, Etokeren and Okwelle (2019) showed that there is no significant difference between male and female students. Based on the inconsistency on the results of male and female students' academic achievement in science, it is pertinent to investigate whether the use of Cooperative Learning Strategy would enhance academic achievement of both male and female students in Chemistry.

The concept of school location refers to schools that are located in rural or urban areas. According to Orji (2013), school location refers to rural and urban schools. Thus, Orji further conceptualized urban schools as those schools in the municipalities or schools found within the towns and rural schools as those located in the villages or semi-urban areas. School location is one of the factors that influence students' academic achievement in some subject areas. Orji (2013) explained that many students in the interior villages struggle with the challenge of walking a long distance to school. The implication is that while people in some urban areas convey their children to school through vehicle and enjoy minimum travelling distances to acquire education, some people in other places suffer by having to cover maximum distances to acquire education; some people in some rural places suffer by having

to cover maximum distances to get to their school (Ezeudu, Olaowei&Umeifekwem, 2014). According to Orji, this may have contributed significantly to students' poor achievement in some rural schools

STATEMENT OF THE PROBLEM

Despite the importance of Chemistry as a pre-requisite to enhance nation's growth and development: over the years, students learning outcomes in the subject has not been encouraging. This is manifested in students' academic achievement in WAEC external examinations for 2015 to 2020 academic session. Chemistry is a science subject that contains a lot of difficult concepts that demands a lot from both the teachers and the students for it to be properly learnt. Students' poor achievement in WAEC as reported by WAEC Chief Examiner's report 2015 to 2020 revealed that there is a continuous decline in students' achievement in Chemistry. This decline may be attributed to the fact that students have resorted to memorization of chemistry concept as a result of their passive involvement in the teaching and learning process due to the lecture method of teaching. It is very obvious that the lecture method of teaching has not truly yielded the required result in terms of students' achievement specifically in Chemistry. This calls for the adoption of other teaching methods that could ensure the active involvement of students in the teaching and learning process and also provide the opportunity for students to discover new knowledge on their own with little or no assistance from teachers. Cooperative learning instruction can be an alternative as it ensure students active involvement in the teaching and learning process and also encourage students' discovery of new knowledge on their own. It is against this background that the study is embark upon to find the efficacy of using cooperative learning strategy to improve students' achievement and retention in Chemistry in Senior Secondary Schools in Jama'a Local Government area of Kaduna State.

OBJECTIVES OF THE STUDY

The objectives of the study are to:

1. determine the difference in the mean achievement scores of students taught 'Stoichiometry' using cooperative learning strategy and those taught using lecture methods;
2. find out the difference in the mean achievement scores of male and female students taught 'Stoichiometry' using co-operative learning strategy;
3. determine the difference in the mean achievement scores of students in urban and rural schools taught 'Stoichiometry' using co-operative learning strategy.

RESEARCH QUESTIONS

The following research questions guided the study:

1. What is the difference in the mean achievement scores of students taught Chemistry using cooperative learning strategy and those taught using lecture method?
2. What is the difference in the mean achievement scores of male and female students taught Chemistry using co-operative learning strategy?
3. What is the difference in mean achievement scores of students in urban and rural schools taught Chemistry using co-operative learning strategy?

HYPOTHESES

The following null hypotheses were tested at 0.05 level of significance.

1. There is no significant difference in the mean achievement scores of students taught Chemistry using co-operative learning strategy and those taught using lecture method.
2. There is no significant difference in the mean achievement scores between male and female students taught Chemistry using co-operative learning
3. There is no significant difference between the mean achievement scores of urban and rural secondary school students taught Chemistry using cooperative learning strategy.

METHODOLOGY

The study adopted the quasi experimental research design involving pre-test-post-test nonequivalent control group design. The population of the study consisted of 543 students from public senior secondary schools in Jema'a LGA. The sample of the study was 180 students drawn from four intact classes. The instrument used for the research was a stoichiometry achievement test (SAT). The instrument was validated by experts in relevant fields. It was trial-tested, and the reliability coefficient stood at 0.70. Mean and standard deviation were used to analyze data for answering the research questions. Analysis of covariance was used to test the hypotheses at 0.05 level of significance.

RESULTS

Research Question One

What is the difference in the mean achievement scores of students taught Chemistry using cooperative learning strategy and those taught using lecture method?

Table 1
Achievement Mean Scores of Students taught Chemistry using the Cooperative Learning Strategy and those taught using Lecture Method

Group		Pre-test		Post-test			
	N	Mean	SD	Mean	SD	Mean Gain	Mean Gain difference
Experimental	**90**	**6.77**	**3.215**	**18.54**	**4.572**	**11.77**	3.94
Control	**90**	**7.83**	**4.821**	**8.88**	**5.134**	**7.83**	

Table 1 shows the pre-test and post-test achievement mean score of students in the experimental and control groups. From the result, the experimental group has a post-test achievement mean score of 18.54 and standard deviation of 4.57 higher than the pre-test mean score of 6.77and standard deviation of 3.22 with a mean gain of 11.77, indicating that there was improvement in the achievement of students after treatment. Also, for the control group the mean score was 7.83 and a standard deviation of 4.82 at the pretest. At the post-test the mean score of students was 8.88 and standard deviation of 7.83. The finding shows that students in the experimental group had a higher mean score (66.93) after treatment using cooperative learning strategy than those in the control group (42.67) who were not given treatment with a mean difference of 24.71. This means that at the pre-test the students in both groups were almost at the same level of achievement, but after intervention the experimental group achieved better than the control group with a mean gain difference of 3.94.

Research Question Two

What is the difference in the mean achievement scores of male and female students taught Chemistry using co-operative learning strategy?

Table 2
Achievement Mean Scores of Male and Female Students after Exposure to Cooperative Learning Strategy

Gender	Test	N	$\bar{x}$	SD	Mean difference
Male	Post-test	45	17.42	4.525	
					2.25
Female	Post-test	45	19.67	4.385	

Table 2 shows the achievement mean scores of male and female students after exposure to cooperative learning strategy. From the result, the post-test achievement mean score for males was 17.42 and a standard deviation of 4.53, while the mean score of females was 19.67 with a standard deviation of 4.39, indicating that there was increase in the achievement of students at the post-test for both male and female students after treatment, although females had a slightly higher achievement mean score than the male students with a mean difference of 2.25. This implies that the achievement mean score of female was better than those of male students in Chemistry.

Research Question Three

What is the difference in mean achievement scores of students in urban and rural schools taught Chemistry using co-operative learning strategy?

Table 3
Achievement Mean Scores of Urban and Rural School Students after Exposure to Cooperative Learning Strategy

Location	Test	N	$\bar{x}$	SD	Mean difference
Urban	Post-test	44	19.84	4.30	
					2.57
Rural	Post-test	46	17.30	4.53	

Table 3 shows the achievement mean scores of urban and rural school students after exposure to cooperative learning strategy. From the result, the post-test achievement mean score for urban school students was 19.84 and a standard deviation of 4.30, while the mean score of rural school students was 17.30 with a standard deviation of 4.53, indicating that there was increase in the achievement of students at the post-test for both urban and rural school students after treatment, although urban school students had a higher achievement mean score than the rural school students with a mean difference of 2.57. This implies that the achievement mean score of urban school students was better than those of rural school students in Chemistry.

Hypothesis One

There is no significant difference in the mean achievement scores of students taught Chemistry using co-operative learning strategy and those taught using lecture method.

Table 4
ANCOVA Result on Posttest Achievement Mean Scores of Students when taught Chemistry Using Cooperative Learning Strategy and Lecture Method

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	5831.267[a]	2	2915.633	200.048	.000	.693
Intercept	2964.268	1	2964.268	203.385	.000	.535
Covariate	1626.267	1	1626.267	111.582	.000	.387
Group	4834.593	1	4834.593	331.713	.000	.652
Error	2579.711	177	14.575			
Total	42250.000	180				
Corrected Total	8410.978	179				

a. R Squared = .693 (Adjusted R Squared = .690)

Analysis of Covariance (ANCOVA) was conducted to determine if a significant difference exists in the posttest achievement mean score of students taught Chemistry using cooperative learning strategy and the lecture method**.** Table 5 shows that $F(1,177) = 331.71$, $p < 0.05$, since the p-value of 0.000 is less than 0.05 level of significance, the null hypothesis was rejected, indicating that there was a significant effect of cooperative learning strategy on achievement of students in Chemistry. The result further reveals an adjusted R squared value of .690 which means that 69 percent of the variation in the dependent variable which is achievement in chemistry is explained by variation in the treatment of cooperative learning strategy, while the remaining is due to other factors not included in this study. It implies that cooperative learning strategy. can help improve students' achievement in Chemistry.

Hypothesis Two
There is no significant difference in the mean achievement scores between male and female students taught Chemistry using co-operative learning strategy.

Table 5
ANCOVA Result of Male and Female Achievement of Students in Chemistry when Exposed to Co-operative Learning Strategy

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	116.602[a]	2	58.301	2.909	.060	.063
Intercept	5041.819	1	5041.819	251.553	.000	.743
Covariate	3.257	1	3.257	.163	.688	.002
Gender	94.242	1	94.242	4.702	.033	.051
Error	1743.720	87	20.043			
Total	32811.000	90				
Corrected Total	1860.322	89				

a. R Squared = .063(Adjusted R Squared = .041)

Analysis of Covariance (ANCOVA) was conducted to determine if there is a significant effect of co-operative learning strategy on achievement of male and female students in Chemistry. Table 5 shows that the main effect of gender yielded $F(1,87) = 4.70$, $p < 0.05$, since the p-value of 0.033 is less than 0.05 level of significance, the null hypothesis was rejected, indicating that there was a significant difference in the achievement mean scores of male and female students exposed to co-operative learning strategy. It implies that co-

operative learning strategy chat generative pre-trained transformer teaching method can help achievement for both male and female students in favour of female students. The value 0.000 is less than 0.05 level of significance, the null hypothesis was rejected, indicating that there was a significant effect of cooperative learning strategy on retention of students in Chemistry. The result further reveals an adjusted R squared value of .690 which means that 69 percent of the variation in the dependent variable which is retention in chemistry is explained by variation in the treatment of cooperative learning strategy, while the remaining is due to other factors not included in this study. It implies that cooperative learning strategy can help students retain what they have been taught in Chemistry.

Hypothesis Three

There is no significant difference between the mean achievement scores of urban and rural secondary school students taught Chemistry using co-operative learning strategy.

Table 6
ANCOVA Result on Urban and Rural School Students Achievement in Chemistry when Exposed to Co-operative Learning Strategy

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	194.931[a]	2	97.465	5.092	.008	.105
Intercept	4608.842	1	4608.842	240.766	.000	.735
Covariate	50.234	1	50.234	2.624	.109	.029
Urban	172.571	1	172.571	9.015	.003	.094
Rural	167.281	1	167.281	8.461	.001	.083
Error	1665.391	87	19.142			
Total	32811.000	90				
Corrected Total	1860.322	89				

a. R Squared = .105(Adjusted R Squared = .084)

Analysis of Covariance (ANCOVA) was conducted to determine if there is a significant effect of co-operative learning strategy on achievement of urban and rural school students in Chemistry. Table 6 shows that the main effect of location yielded $F(1,87) = 4.70$, $p < 0.05$, since the p-value of 0.003 is less than 0.05 level of significance, the null hypothesis was rejected, indicating that there was a significant difference in the achievement mean scores of urban and rural school students exposed to co-operative learning strategy. It implies that co-operative learning strategy can help improve the achievement of both urban and rural school students in favour of urban school students.

DISCUSSION

The study analyzes the effectiveness of cooperative learning strategies on senior secondary two student's achievement and retention in chemistry in Jema'a Kaduna State. The results showed that exposure to cooperative learning strategy was found to be more effective in improving the achievement and retention of secondary school students in chemistry as indicated in the result that there is a significant difference between the posttest achievements of students taught chemistry with cooperative learning strategy and lecture method. The effectiveness of cooperative learning strategy could be because it is a strategy that centers on group interaction, discussions, and exchange of ideas in class. It gives opportunity for all to sit and listen, as well as talk and think, thus emphasizing the process of "coming to know" as

valuable as "knowing the right answer". In other words, students in a cooperative class are not passive listeners neither is the teacher a sole performer. Students are allowed to develop critical thinking ability, learn to evaluate ideas, concepts and principles, procedure, program and policies on the basis of clearly set criteria. The findings is in line with the work of Yousef, Algani, Younis and Alhaija (2020) who carried a study to examine the effect of Cooperative Learning method on Students 'academic achievement in Mathematics and found the cooperative was effective in improving student achievement in mathematics.

The second result of the study showed that there is a significant difference between the mean achievement scores of male and female students taught chemistry with cooperative learning instructional strategy. The female students in the cooperative learning instructional strategy (experimental) group outscored their counterparts (male students) in the group. This may be attributed to the fact that there was active involvement and interaction among students, between students and teachers, between students and learning environment in the experimental group. This may have boosted the mean achievement scores of the female students in the experimental group because there is internal satisfaction derived from self-discovery of knowledge. This finding is in consistence with the finding of Nnorom (2015) who observed that cooperative learning instructional strategy was more effective in facilitating students' conceptualization of science concepts than the lecture method.

The findings on the retention mean score of students taught chemistry using cooperative learning strategy and those taught with lecture method revealed that the improvement in the achievement of students was retained after treatment. The findings show that students in the experimental group had a higher retention mean score after treatment using cooperative learning strategy than those in the control group who were taught using lecture method. This means that after the intervention the achievement of students taught using cooperative learning strategy was retained better than those who were not given the intervention. It can be deduced that cooperative learning strategy does increase students' retention mean score in chemistry. This finding concurs with the work of Adeniji (2018) who found that cooperative learning promotes students' retention in science in senior secondary schools.

The fourth result of the study showed that there is a significant difference between the mean achievement scores of students taught Chemistry in urban and rural schools using cooperative learning strategy. Students in urban school taught Chemistry using cooperative learning instructional strategy outperformed their rural counterparts taught with cooperative learning instructional strategy. The explanation for the observed significant difference in the mean achievement scores of students in urban and rural schools is that there is a gap that existed between the surrounding of rural schools which usually have inadequate human and material resources as compared to urban scores which have lot of fascinating and stimulating materials for teaching as well as larger number of teachers to teach. This finding contradicts the view of Mathew (2014) who observed a significant difference between the mean achievement scores of students in urban and rural schools taught chemistry with cooperative learning instructional strategy, in favour of the students in rural schools.

CONCLUSION AND RECOMMENDATIONS

From the findings of this study, it could be concluded that, the achievement level of both groups of students before treatments were low in Chemistry. The result further showed that students taught using cooperative learning strategy performed significantly better than their counterparts taught with lecture method. Cooperative strategy was found to be more effective in improving the achievement and retention of secondary school students in

chemistry when compared to lecture method. Gender had effect when taught with cooperative learning strategy. It was discovered that, the student in urban schools perform better than their counterpart in rural schools when taught chemistry using cooperative learning strategy.

In view of the findings of the study, the following recommendations are made:

1. Chemistry teachers should adopt the use of cooperative learning instructional strategy in the teaching of Chemistry at the senior secondary school level. This instructional strategy may ensure students active involvement, self-discovery of knowledge, as well as giving students the opportunity to learn from other students' concepts, they could not learn on their own.
2. Special training on the effective implementation of cooperative learning instructional strategy should always be organized for teachers and students by the state government, so as to help them become competent in the use of this teaching strategy in the teaching and learning process.
3. Curriculum planners for senior secondary school should incorporate good and appropriate approaches such as cooperative learning strategy in the teaching of Chemistry.

4 interest, attitude, anxiety, and study habits.

5 A study of similar nature should be carried out in other local government areas of Kaduna State.

6 Cooperative learning strategy can be compared to other teaching strategies such as guided discovery, inquiry strategy, activity based method, and think-pair-share strategies.

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