

EFFECTS OF COOPERATIVE AND INDIVIDUALIZED INSTRUCTIONAL STRATEGIES ON SENIOR SECONDARY SCHOOL CHEMISTRY STUDENTS' ACADEMIC ACHIEVEMENT AND RETENTION IN ADAMAWA STATE, NIGERIA

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Abstract

This study investigated the effect of Cooperative and Individualized Instructional Strategies on Senior Secondary School Chemistry Students' Academic Achievement and Retention in Adamawa State. Four objectives and four research questions guided the study while four null hypotheses were formulated and tested at 0.05 level of significance. A pre-test, post-test, nonequivalent control group Quasi experimental research designed was employed for the study. The population of the study was 1,343 students, which consisted of all the Senior Secondary II (SSS2) Chemistry students in Adamawa State. The study sampled 183 students using multistage sampling technique from three public senior secondary schools. The instrument used to generate data for the study was Chemistry Achievement Test (CAT). The instrument was given to three experts; two in the Department of Organic Chemistry and one in the Department of Life Science Education of Modibbo Adama University of Technology Yola to review the content, adequacy of items and their relevance to the study. The suggestions made by these experts was incorporated into the final draft of the instrument. Kuder-Richardson (KR-20) reliability technique was used to test the reliability of the instrument. A reliability coefficient of 0.87 was obtained. Mean and standard deviation were used to answer the research questions, while the hypotheses were tested at 0.05 level of significance using Analysis of Covariance (ANCOVA). The findings of the study revealed among others, that there was a significant difference in the mean achievement scores of Chemistry students taught through cooperative, individualized and lecture method ($F_{(183)} = 31.16$; $p < 0.05$); gender is not a significant factor affecting students' academic achievement when taught Chemistry under cooperative, individualized and lecture method ($F_{(183)} = 0.31$; $p > 0.05$); there was a significant difference in the mean retention score of Chemistry students taught through cooperative, individualized and those taught using lecture method ($F_{(183)} = 89.882$; $p < 0.05$); and male and female students taught Chemistry under cooperative, individualized and lecture method did not differ in their retention ability ($F_{(183)} = 4.798$; $p > 0.05$). The study recommended among others, that Chemistry teachers should adopt the use of instructional strategies that will encourage students to develop and use cooperative and individualized learning strategy in teaching and learning Chemistry concepts, and the strategies have the tendency of not only enhancing achievement but also of reducing the gender bias.

Keywords: Cooperative Instructional Strategy, Individualized Instructional Strategy, Academic Achievement, Retention, Gender, Chemistry.

Introduction

Chemistry is a natural science, which plays very crucial roles in scientific and economic development of nations. It is the study of the nature and properties of all forms of matter as well as substances that make up our environment and the various changes, which these substances undergo in different conditions (Umaru, 2015). Chemistry occupies a central position among the sciences due to its remarkable contribution in medicine, biochemistry, microbiology, pharmacy, textile industry, engineering, petroleum and agriculture to mention but a few (Jegede, 2010). The world is regarded as a chemical world because everything in the environment consists of one chemical substance or the other. In view of the foregoing, the importance of Chemistry as one of the potent tools for a nation's overall sustainable development can hardly be overemphasized. Consequently, Nigeria hopes to achieve technological and economic development and self-reliance for her citizens through science education.

Many researchers agreed that the conventional lecture method does not help students construct their own understanding and opined that the uninspiring teaching methods adopted by science teachers

lead not only to low achievement in the science but also incapacitates students from developing required skills necessary for creative thinking (Igboanugo, 2013 & Nneka, 2015). The lecture method is a teaching method in which the teacher presents a verbal discourse on a particular subject, theme or concept to the learners, the teacher deliver preplanned lessons to the students with little or no instructional aides (Ogbonne&Offorma, 2013). Danmole (2011) noted that teachers need to employ different learning methods and strategies to unsure students understanding of scientific concepts. A shift is therefore advocated by researchers to methods that will enable the learner construct his/her own understanding (Samba, Achir&Ogbeba, 2012; and Samba &Lortim, 2014). Such methods have their roots in constructivism. This trend is learner centered and among these strategies are the cooperative and individualized instructional strategy.

Cooperative instructional strategy is a systematic pedagogical strategy that encourages small groups of students to work together for the achievement of common goals (Umaru, 2015). During cooperative instruction students are grouped heterogeneously in four or five based on sex, academic abilities and tribe/state/race, among others, and work together in small group where each individual of the group interact with one another until the assigned task is successfully accomplished under the guidance of the teacher (Omoregbe & Ewansiba, 2013).

Individualized instructional strategy according to David (2017) is an instructional strategy in which the content, instructional materials, instructional media, and pace of learning are based upon the abilities and interests of each individual learner. Individualized instruction yields a huge net benefit by freeing teachers to focus upon the needs and problems of individual students, as the facilitator of learning. Individualized instruction is a constructivist's approach of learning in which the student is expected to build his or her learning and knowledge. Many researchers (Oyibe and Nnamani, 2014; Nnamani and Oyibe, 2016) support the effectiveness of individualized instructional strategy in teaching and learning. Olaebhiele (2011) for example is of the view that proper use of individualized instructional strategy in teaching and learning of social studies will encourage skills acquisition and development of values. David (2017) in his view held that the use of individualized instruction in teaching Chemistry in secondary school enables the teacher to see each learner as a unique being that possess certain peculiar traits, potentials and abilities.

Arvind and Kusum (2016) stressed that the differences between instructional strategies and teaching method should be noted. Method is the term of pedagogy; main focus is on effective presentation of subject matter to have mastery over it. It is step by step scientific way of presenting the subject matter. It is overall plan for systematic presentation based on a selected approach means method is the practical realization of an approach through a procedure in a system. Teaching method is what kind of activity we use in order to teach. Method refers to the procedure within an approach. It is a process or procedure whose successful completion results in learning or as a means through which teaching becomes effective. The term method covers both strategy and techniques of teaching. Different strategies may be adopted in following a method.

The term strategy has been borrowed from military science. According to Arvind and Kusum (2016), strategy is the science or art of planning and directing large military movements and operations. It refers to the pattern of acts that serve to attain certain outcomes. If we use strategy in teaching learning situations, then it is known as instructional strategies. It means the determination of some policy before presenting the content with the help of which teaching objectives are achieved. It is some sought of planning for achieving goals. Strategy is that skillf ulplanning of a working system by which the objectives can be achieved easily. Strategy changes according to the changing situation. Teaching strategy is the means to achieve learning objectives. According to Mtunda and Safuli (2012) teaching strategy is a generalized plan for a lesson which includes structure, desired learner behavior in terms of goals of instruction and an outline of planned tactics necessary to implement the strategy.

Retention is the ability to reproduce a learnt concept or skills when the need arises. For so long, researchers have been keen on knowing what can be done by teachers to enhance maximum retention of knowledge or skills long after they have been acquired whether in the classroom or outside the classroom (Agu& Samuel, 2018). Generally, it is believed that the more the human senses are brought into interaction during the learning process, the greater the retention capacity of the

learner. This explains why the use of varied teaching methods is increasingly advocated in the education industry. The ability of students to retain knowledge and skills better after completing a course is becoming increasingly relevant and a focus on deep learning and represents a priority for educational research in general (Darlan & Carmicheal, 2012). In promoting greater achievement, some studies reported that co-operative learning also foster greater retention of learning as indicated by students' results (Sousa, 2006). Tran (2014) reported that a blend of 'telling' and 'showing' techniques results in greater retention of 65 percent.

Based on the forgone, the present study intends to use co-operative and individualized strategies, in teaching some difficult concepts in Chemistry such as nature of matter and separating techniques to see or observe their effect. To achieve this objective, four research questions were constructed to guide this study as follows:

1. What are the mean achievement scores of secondary school students taught Chemistry with cooperative, individualized instructional strategies and lecture method?
2. What is the mean achievement scores of male and female secondary school students taught Chemistry with cooperative, individualized instructional strategies and lecture method?
3. What are the mean retention scores of Chemistry students taught with cooperative, individualized instructional strategies and lecture method?
4. What is the mean retention scores of male and female secondary school students taught Chemistry with cooperative, individualized instructional strategies and lecture method?

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

- Ho₁: There is no significant difference in the mean achievement scores of Chemistry students taught with cooperative, individualized instructional strategies and lecture method.
- Ho₂: There is no significant difference between the mean achievement scores of male and female Chemistry students taught using cooperative, individualized instructional strategies and lecture method.
- Ho₃: There is no significant difference in the mean retention score of Chemistry students taught with cooperative, individualized instructional strategies and lecture method.
- Ho₄: There is no significant difference between the mean retention scores of male and female Chemistry students taught using cooperative, individualized instructional strategies and lecture method.

Methodology

The quasi-experimental research design that employed a pretest-posttest, non-equivalent control group was used for the study. The non-equivalent control group was used because, it is natural to use intact classroom in a school for a quasi-experimental study than to start creating groups through random selection (Sambo, 2005). A sample size of 183 Senior Secondary II Students were selected through multistage sampling technique. At first-stage, a simple random sampling technique (raffle draw) was used to select one local government out of the four local government areas in Yola Educational Zone of Adamawa State. The second state was the use of purposive sampling technique to select three schools with adequate teaching facilities and qualified Biology teachers for the experimental activities. Two schools were assigned for experimental treatment condition, while the other one for control group. The instrument used for data collection was Chemistry Achievement Test (CAT) constructed by the researchers based on the Chemistry topics of Nature of Matter and Separation Techniques taught which was part of SSII Chemistry curriculum. The validation of CAT was done by three specialists in the Department of Life Science Education, and Department of Organic Chemistry of ModibboAdama University of Technology Yola. Kuder-Richardson (KR-20) reliability technique was used to estimate the reliability of the CAT. The reliability coefficient obtained was 0.87.

The regular Chemistry class teachers were used for the study in both experimental (cooperative and individualized instructional strategies) and control groups (lecture). Training was given to the Chemistry teachers who took the experimental groups on the application of the instructional strategies (cooperative and individualized instructional strategies), while the Chemistry teacher who took the control group used the conventional method. The teachers explained the features and practice of cooperative and individualized instructional strategies to the students. The experimental

class teachers were given lesson prepared by the researcher while the researcher vetted the lesson plan prepared by the Chemistry teacher in the control group to ensure that the teachers did not deviate from the procedures of instructions commonly used by Chemistry teachers. Chemistry Achievement Test (CAT) was used for both pre-tests before treatment, post-test after treatment and retention test two weeks after post-test. Mean and standard deviation was used for answering the research questions, and Analysis of Covariance (ANCOVA) was used for testing the hypotheses at 0.05 level of significance.

Result

Research Question 1: What is the mean achievement scores of secondary school students taught Chemistry with cooperative, individualized and lecture method.

Table 1: Mean and Standard deviation of achievement test scores of secondary school students taught Chemistry with cooperative, individualized instructional strategies and lecture method.

Experimental Conditions	Variables	Pre-Test			Post-Test		Mean Gain
		N	$\bar{x}$	SD	$\bar{x}$	SD	
Exp. 1	Cooperative	49	29.06	4.38	46.12	4.59	17.06
Exp. 2	Individualized	68	28.93	3.85	44.28	5.30	15.35
Control	Lecture	66	27.00	3.92	42.24	4.13	15.24
Total		183					

Key: $\bar{x}$ = mean, N = number of respondents, SD= Standard Deviation

Table 1 shows that the students in the cooperative group had a pretest achievement mean score of 29.06 with a standard deviation of 4.38 and a post-test mean score of 46.12 with a standard deviation of 4.59. The difference between the pre and post achievement mean scores for the cooperative group was 17.06. The individualized group had a pre achievement mean score of 28.93 with a standard deviation of 3.85 and a post achievement mean score 44.28 with a standard deviation of 5.30. The difference between the pre and post-test achievement mean scores for individualized group was 15.35. For the Lecture group, a pre-test achievement mean score of 27.0 with a standard deviation of 3.92 and post-test achievement mean score of 42.24 with a standard deviation of 4.13 were obtained. The difference between the pre and post-test achievement mean for lecture (control) group was 15.24. However, for each of the groups, the post-test achievement mean score was greater than the pre-test mean with the students taught Chemistry with cooperative strategy having the higher mean gain, followed by individualized strategy. This result shows that cooperative and individualized instructional strategies leads to students' higher achievement in Chemistry more than the lecture method of teaching.

Research Question 2: What is the mean achievement scores of male and female secondary school students taught Chemistry with cooperative, individualized instructional strategies and lecture method?

Table 2: Mean achievement test scores of male and female secondary school students taught Chemistry with cooperative, individualized instructional strategies and lecture method.

Gender	Cooperative				Individualized				Lecture			
	N	Pre test	Post test	Mean gain	N	Pre test	Post test	Mean gain	N	Pre test	Post test	Mean gain
Male	27	28.11	45.52	17.41	44	29.75	44.72	14.97	39	26.85	42.19	15.34
Female	22	30.23	46.86	16.63	24	27.42	43.46	16.04	27	27.16	42.32	15.16

Key: N = number of respondents

The result presented in Table 2 shows that for the students taught Chemistry with cooperating instructional strategy, the males had a pre-test achievement mean score of 28.11, post-test achievement scores of 45.52 and a mean gain of 17.41. For the females, the pre-test achievement mean score was 30.23, a post-test achievement mean score of 46.86 and a mean gain of 16.63 was

obtained. For the individualized group, result shows that the male had pre-test achievement mean scores of 29.75, post-test achievement score of 44.72 and mean gain of 14.97. For the females, the pre-test achievement mean score of 27.42, post-test mean achievement score of 43.46 and mean gain of 16.04 was obtained. For the lecture group, result shows that the male had a pre-test achievement scores of 26.85, a post-test mean achievement score of 42.19 and a mean gain of 15.34. For the females, a pre-test achievement mean score of 27.16, a post-test achievement mean score of 42.32 and a mean gain of 15.16 was obtained. This shows that the male students taught Chemistry with cooperative and individualized instructional strategies have achieved higher than their female counterparts under the three learning groups.

Research Question 3: What are the mean retention scores of Chemistry students taught with cooperative, individualized instructional strategies and lecture method?

Table 3: Mean retention test scores of secondary school students taught Chemistry with cooperative, individualized instructional strategies and lecture method.

Variables	N	Post-Test	Retention-Test	Mean Gain
		$\bar{x}$	$\bar{x}$	
Cooperative	49	46.19	49.63	3.44
Individualized	68	44.09	45.04	0.95
Lecture	66	42.26	44.24	1.98

Key: $\bar{x}$ = mean, N = number of respondents

Result in Table 3 shows that the students in cooperative group had a post-test achievement mean score of 46.19, mean retention score of 49.63 and a mean gain of 3.44. A post-test achievement mean score of 44.09, mean retention score of 45.04 and mean gain of 0.95 was obtained for the individualized group. While for the lecture (control) group; a post-test achievement mean score of 42.26, mean retention score of 44.24 and mean gain of 1.98 was obtained. This result shows that students taught Chemistry with either cooperative, individualized or both had the ability to retain information better than that of students taught Chemistry using lecture method.

Research Question 4: What is the mean retention scores of male and female secondary school students taught Chemistry with cooperative, individualized instructional strategies and lecture method?

Table 4: Mean and Standard deviation of retention test scores of male and female secondary school students taught Chemistry with cooperative, individualized instructional strategies and lecture method.

Gender	Cooperative			Individualized			Lecture		
	N	$\bar{x}$	SD	N	$\bar{x}$	SD	N	$\bar{x}$	SD
Male	27	49.88	1.91	44	46.02	2.63	39	43.85	2.08
Female	22	46.45	4.68	24	43.25	0.79	27	41.88	2.09

Key: $\bar{x}$ = mean, N = number of respondents, SD= Standard Deviation

Result in Table 4 shows that the males in cooperative group had a mean retention score of 49.88 with a standard deviation of 1.91 while the females had a mean retention score of 46.45 with a standard deviation of 4.68. A mean retention score of 46.02 with a standard deviation of 2.63 were obtained for males in the individualized group, while for the females a mean retention score of 43.25 with a standard deviation of 0.79 was obtained. For the lecture group, a mean retention score of 43.85 with a standard deviation of 2.08 was obtained for the male while for the females, a mean retention score of 41.88 with a standard deviation of 2.09 was obtained. Results showed that there is a little or no difference in the mean retention scores of male and female students taught Chemistry with cooperative, individualized and lecture method.

Research Hypothesis 1: There is no significant difference in the mean achievement scores of Chemistry students taught through cooperative and individualized instructional strategies and those taught through lecture method.

Table 5: Analysis of Covariance on significant difference in the mean achievement scores of Chemistry students taught with cooperative, individualized and lecture method.

Sourced	Type III Sum of Squares	df	Mean Square	F	Sig.	Decision
Corrected Model	431.878	3	143.959	21.211	.000	
Intercept	7209.155	1	7209.155	1062.217	.000	
Pre-test	2.223	1	2.223	.328	.568	
Group	423.031	2	211.516	31.165	.000	Reject
Error	1214.854	179	6.787			
Total	356551.000	183				
Corrected Total	1646.732	182				

a.R Squared = .263 (Adjusted R Squared = .250)

The result in Table 5 shows that with respect to the academic achievement mean scores of students taught Chemistry with cooperative, individualized and lecture method, an F-ratio of 31.16 was obtained with associated exact probability value of 0.00. Since the associated probability (0.00) was less than 0.05 set as level of significance, the null hypothesis (H_{01}) which states that there is no significant difference in the mean achievement scores of Chemistry students taught with cooperative, individualized instructional strategies and those taught with lecture method is rejected. Thus, reference drawn is that there was a significant difference in the mean achievement scores of students taught Chemistry with cooperative, individualize instructional strategies and those taught through lecture method with those taught with cooperative and individualized instructional strategies having a higher mean gain. This shows that cooperative and individualized instructional strategies increased students' academic achievement in Chemistry more than lecture method.

Hypothesis 2: There is no significant difference between the mean achievement scores of male and female Chemistry students taught with cooperative and individualized instructional strategies and those taught using lecture method.

Table 6: Analysis of Covariance on significant difference between the mean achievement scores of male and female Chemistry students taught with cooperative, individualized lecture method.

Sourced	Type III Sum of Squares	df	Mean Square	F	Sig.	Decision
Corrected Model	486.249	6	81.042	12.291	.000	
Intercept	7149.921	1	7149.921	1084.364	.000	
Pre-test	9.413	1	9.413	1.428	.234	
Group	429.443	2	214.722	32.565	.000	
Sex	.201	1	.201	.031	.861	Accept
Group * Sex	54.310	2	27.155	4.118	.018	
Error	1160.483	176	6.594			
Total	356551.000	183				
Corrected Total	1646.732	182				

a.R Squared = .295 (Adjusted R Squared = .271)

The result in Table 6 shows that with respect to the academic achievement scores of male and female students taught Chemistry with cooperative, individualized instructional strategies and lecture, an F-ratio of .031 was obtained with associated probability value of 0.86. Since the associated probability value (0.86) is greater than 0.05 set as bench mark, the null hypothesis (H_{02}) which stated that there is no significant difference between the mean achievement scores of male and female Chemistry students taught with cooperative, individualized instructional strategies and those taught using lecture method was accepted. Thus, inference drawn in that, male and female students taught Chemistry with cooperative, individualized and lecture method did not differ significantly in their academic achievement. This result showed that gender is not a significant factor affecting students' academic achievement when taught Chemistry with cooperative, individualized and lecture method.

Hypothesis 3: There is no significant difference in the mean retention score of Chemistry students taught with cooperative and individualized instructional strategies and those taught with lecture method.

Table 7: Analysis of Covariance on significant difference in the mean retention score of Chemistry students taught with cooperative, individualized and those taught with lecture method.

Sourced	Type III Sum of Squares	df	Mean Square	F	Sig.	Decision
Corrected Model	913.802	3	304.601	62.019	.000	
Intercept	7444.294	1	7444.294	1515.703	.000	
Pre-test	1.228	1	1.228	0.250	.618	
Group	882.897	2	441.449	89.882	.000	Reject
Error	879.149	179	4.911			
Total	388745.000	183				
Corrected Total	1792.951	182				

a.R Squared = .510 (Adjusted R Squared = .501)

The result in Table 7 shows that with respect to the mean retention scores of students taught Chemistry under cooperative, individualized and lecture groups, an F-ratio of 89.882 was obtained with associated exact probability value of 0.00. Since the associated probability (0.00) was less than 0.05 set as level of significance, the null hypothesis (H_{03}) which states that there is no significant difference in the mean retention scores of Chemistry students taught with cooperative, individualized instructional strategies and those taught through lecture method is rejected. Thus, reference drawn is that there was a significant difference in the mean retention scores of students taught Chemistry in a cooperative and individualize instructional strategies lecture and those taught using lecture method with those taught with cooperative and individualized instructional strategies having a higher mean gain. This shows that cooperative and individualized instructional strategies increased students' retention in Chemistry more than those taught with lecture method.

Hypothesis 4: There is no significant difference between the mean retention scores of male and female Chemistry students taught with cooperative and individualized instructional strategies and those taught using lecture method.

Table 8: Analysis of Covariance on significant difference between the mean retention scores of male and female Chemistry students taught with cooperative, individualized and lecture method.

Sourced	Type III Sum of Squares	df	Mean Square	F	Sig.	Decision
Corrected Model	1050.091	6	175.015	41.465	.000	
Intercept	7388.863	1	7388.863	1750.586	.000	
Pre-test	.500	1	.500	119	.731	
Group	898.349	2	449.174	106.419	.000	
Sex	20.250	1	20.250	4.798	.030	Accept
Group * Sex	114.146	2	57.073	13.522	.000	
Error	742.860	176	4.221			
Total	388745.000	183				
Corrected Total	1792.951	182				

a.R Squared = .586 (Adjusted R Squared = .572)

The result in Table 8 shows that with respect to the retention scores of male and female students taught Chemistry through cooperative, individualized instructional strategies and lecture, an F-ratio of 4.798 was obtained with associated probability value of 0.30. Since the associated probability value (0.30) is greater than 0.05 set as bench mark, the null hypothesis (H_{04}) which stated that there is no significant difference between the mean retention scores of male and female Chemistry students taught with cooperative, individualized instructional strategies and those taught with lecture method was accepted. Thus, inference drawn is that, male and female students taught Chemistry under cooperative, individualized and lecture method did not differ significantly in their retention ability. This result showed that gender is not a significant factor affecting students' retention when taught Chemistry under cooperative, individualized and lecture method.

Findings of the Study

The result of the study revealed the following:

1. Cooperative and individualized instructional strategies leads to students' higher achievement in Chemistry more than the lecture method of teaching.
2. Gender seems to have some effects on students' academic achievement in Chemistry.
3. Students taught Chemistry with either cooperative, individualized or both had the ability to retain information better than that of students taught Chemistry using lecture method.
4. There is little difference in the mean retention scores of male and female students taught Chemistry with cooperative, individualize and lecture method.
5. There was a significant difference in the mean achievement scores of Chemistry students taught cooperative, individualized instructional strategies and those taught through lecture method ($F_{(183)} = 31.16$; $p < 0.05$).
6. There was no significant difference in the mean achievement scores of male and female Chemistry students taught using cooperative, individualized instructional strategies and those taught with lecture method ($F_{(183)} = 0.31$; $p > 0.05$).
7. There was a significant difference in the mean retention score of Chemistry students taught through cooperative, individualized instructional strategies and those taught with lecture method ($F_{(183)} = 89.882$; $p < 0.05$).
8. There was no significant difference in the mean retention scores of male and female Chemistry students taught using cooperative, individualized instructional strategies and those taught with lecture method ($F_{(183)} = 4.798$; $p > 0.05$).

Discussion of Findings

The findings of this study as presented in Tables 1 and 5 indicated that students taught with cooperative and individualized instructional strategies perform better than those taught using lecture method. This result is in line with Nneka's (2015) view that students' academic achievement could be enhanced through the use of good instructional strategies that will stimulate them. The result of the study also revealed cooperative and individualized learning strategies as strategies that has the potential of exposing students to different types of scientific activities which are reflected in their academic performance. Justifying the above statement, Danjuma (2015) opined that the way in which the science teacher handle students in an instructional setting in a science class goes a long way in helping them to perform better in science subjects by identifying the needs of the students, by acknowledging their little successes, by making the classroom students friendly which attracted them to the activities in the classroom and also by recognizing and respecting students' views which led to boosting and developing confidence in the students. Therefore, with cooperative and individualized instructional strategies, learners are subjected to activities that aid their academic performance. This explains the overall higher mean scores of students exposed to cooperative and individualized instructional strategies over lecture method of teaching.

Results from Tables 2 and 6 confirms that gender does not have significant effect on the academic achievement. This implies that the gender gap is reducing. This is in line with the view of Clement, Ugustine, Odihi and Sunday (2017) who submitted that differences between boys and girls in the area of academic achievement in science are now very small. The findings of the study also showed that the reduction in gender gap is due to the teacher's effort in presenting well designed tasks to the students which in turn challenged the female students to give their best through the use of cooperative and individualized instruction strategies thus reducing the gender gap. This indicates that the use of the instructional strategies under study reduce the gender gap in favour of the female. This is not surprising because Wael (2014) observed that exposing students to appropriate activities reduces gender gap in science.

Tables 3 and 7 confirms that cooperative, individualized instructional strategies and lecture method had significant effect on students' retention in Chemistry. The groups exposed to cooperative and individualized instructional strategies group performed better than the competitive group that went through the lecture method of teaching. Hence, the cooperative and individualized instructional strategies appeared to have facilitated the retention of Chemistry among the students more than the lecture method of instruction. This indicates that the difference in mean retention scores was significant. The finding is in line to the findings of Agu and Samuel (2018) who stated that

cooperative and individualized instructional strategies increases students' academic achievement and retention.

Tables 4 and 8 confirms that gender does not have significant effect on the academic retention. This is in line with the view of Jimmoh (2016) and Ezenwosu&Nwogu (2013) who submitted that differences between boys and girls in the area of academic retention in science are now very small. From the foregoing, it could be deduced from the findings of the study that female students developed a seemingly higher academic achievement because the classroom was student friendly and their little effort and successes were acknowledged. It could also be attributed to the fact that their views were recognized and respected which have boosted and developed their confidence in their ability to develop and apply cooperative and individualized instructional strategies in the learning of Chemistry. However, the gender influence on academic achievement of male and female students taught Chemistry using the two instructional strategies was not significant.

Conclusion

Based on the findings of the study, the researcher drew the following conclusions.

1. The use of cooperative and individualized learning strategies in learning Chemistry concepts leads to increase in students' academic achievement more than the use of lecture method.
2. Although differences seem to exist in the mean achievement scores of male and female students, gender is not a significant factor affecting students' academic achievement in Chemistry when taught through cooperative and individualized instructional strategies.
3. The use of cooperative and individualized learning strategies in learning Chemistry concepts leads to increase in students' retention more than the use of lecture method.
4. The use of cooperative and individualized instructional strategies results in students' higher achievement than the use of lecture method.
5. Gender is not a significant factor affecting students' retention in Chemistry when taught under cooperative and individualized instructional strategies.

Recommendations

Based on the findings of the study, the following recommendations are proffered:

1. Chemistry students should be taught with student-centred and activity-based methods of instruction, such as the Cooperative Instructional Strategy and Individualized Learning Instructional Strategy, to encourage social interaction, active engagement and self-motivation among learners;
2. These innovative teaching strategies should be incorporated into the Chemistry curriculum of teacher training tertiary institutions in Nigeria, in order to popularize their use among the teacher trainees;
3. The teachers of secondary school chemistry in Nigeria should attend conferences, workshops and seminars regularly, where they would learn the requisite skills and knowledge to handle these innovative teaching strategies in their classrooms; and
4. Government agencies and professional bodies such as the Nigerian Educational Research and Development Council (NERDC) and Science Teachers' Association of Nigeria (STAN) should sponsor and publish further research on the efficacies of these student-centered and activity-based teaching strategies in enhancing students' academic achievement in Chemistry and other Science subjects.

References

- Agu, A. P. & Samuel, I. R. (2018). Effect of cooperative learning (STAD, JIGSAW II and TAI) strategies on students' achievement and retention in basic science and technology. *International Journal of Modern Education Research*, 5(2), 26-31.
- Arvind, K. G. & Kusum, G. (2016). Teaching Approaches, Methods and Strategy. *Scholarly Research Journal for interdisciplinary Studies*, 1(2), 1-4.
- Clement, O. I., Ugustina, N. O. O., Odihi, A. & Sunday, E. A. (2017). Effect of collaborative instructional strategy on male and female students' achievement in secondary school chemistry in Benue State, Nigeria. *International Journal of Pharmacy and Chemistry*, 3(6), 94-98.

- Danjuma, G. S. (2015). Effects of collaborative and competitive learning strategies on Upper Basic II students' interest and achievement in Basic Science. Unpublished PhD. Thesis, University of Nsukka, Nigeria.
- Danmole, B. T. (2011). Emerging issues on the universal basic education curriculum in Nigeria: Implications for the science and technology component. *Pakistan Journal of Social Sciences*, 8(1) 62-68.
- Darlan, D. C. & Carmicheal, J. S. (2012). Long-term retention of knowledge and critical thinking skills. *Journal of Microbiology and Biology Education*, 13(2), 1-4.
- David, A. U. (2017). Comparative effects of individualized and cooperative learning instructional strategies on senior secondary school students' academic achievement in organism chemistry. *Electronic Journal of Science Education*, 22(2), 1-14.
- Ezenwosu, S. U. & Nworgu, L. N. (2013). Efficacy of peer tutoring and gender on students' achievement in Biology. *International Journal of Scientific Research*, 4(12), 944-950.
- Igboanugo, B. I. (2013). Effects of peer teaching on students' achievement and interest in difficult chemistry concepts. *International Journal of Educational Research*. 72(2) 61-71.
- Igboanugo, B. I., (2013). Effects of peer teaching on students' achievement and interest in difficult chemistry concepts. *International Journal of Educational Research*. 72(2) 61-71.
- Jegede, S. A. (2010). Nigerian students' perception of technical words in senior secondary school chemistry curriculum. *Pakistan Journal of Social Sciences*, 7(2), 109-111.
- Jimmoh, A. G., Idris, L. O. & Olatunji, B. A. (2016). Effect of jigsaw cooperative learning strategy and gender on students' academic achievement in cost accounting in colleges of education in Ogun State, Nigeria. *International Journal of Academic Research in Education and Review*, 4(5), 150-157.
- Mtunda, F. G. & Safuli, S. D. S. (2012). Theory and practice of teaching. Blantyre: Dzuka. Mzumara PS. In-service course material for teacher educators. New York: Jossey bass.
- Nnamani, S. C. & Oyibe, O. A. (2016). Effects of individualized instructional method on secondary school students' achievement in social studies. *British Journal of Education*., 4(3), 110-120.
- Nneke, R. N. (2015). Effect of Cooperative learning instructional strategy on senior secondary school students' achievement in Biology in Anambra State of Nigeria. *International Journal for Cross Disciplinary Subjects in Education (IJCDSE)*, 5(1), 2424-2427.
- Odoh, C. O. (2013). Effects of cooperative instructional strategy on students' achievement in senior secondary school Chemistry. *Journal of Research in Curriculum and Teaching*, 7(1), 583-589.
- Ogbonne, U. T. & Offorma, G. U. (2013). Effects of collaborative learning method on secondary student interest in English language tenses. *International Journal of educational Research*, 12(2), 28-135.
- Ogbonne, U. T. & Offorma, G. U. (2013). Effects of collaborative learning method on secondary student interest in English language tenses. *International Journal of Educational Research*, 12(2) 28-135.
- Oleabhiere, E. O. (2011). Effects of individualized and cooperative learning methods on senior secondary school students' achievement in Economics. An Unpublished Ph.D. dissertation, Ebonyi State University, Abakaliki.

- Omeregbe, E. & Ewansiba, J. C. (2013). The challenge of effective science teaching in Nigerian secondary schools. *Academic Journal of Interdisciplinary Studies*, 2(7), 181- 188.
- Oyibe, O. A. & Nnamani, S. C. (2014). Students' preference of instructional methods used in teaching and learning of Social Studies in Abakaliki Metropolis. *International Journal of Learning and Development*, 5(1), 10-18.
- Samba, R. M. O. & Eriba, J. (2012). *Innovative approaches in teaching difficult science concepts*. Markurdi: Destiny ventures.
- Samba, R. M. O. & Lortim, O. S. (2014). Using cooperative learning instructional strategy to foster social skills in senior secondary biology students in Benue State: A bed rock for creativity. 55th Annual Conference Proceeding of Science Teachers Association of Nigeria, 207-222.
- Samba, R. M. O. & Lortim, O. S. (2014). Using cooperative learning instructional strategy to foster social skills in senior secondary biology students in Benue State: A bed rock for creativity. 55th annual conference proceeding of Science Teachers Association of Nigeria. 207-222.
- Samba, R. M. O., Achir, E. E. & Ogbeba, J. (2012). Teacher awareness and utilization of innovative teaching strategies in Benue state. *Nigeria Educational Research*, 1(2) 032 – 038.
- Sousa, D. A. (2006). *How the brain learns*. Harthernton, Vic: Hawker Brownlow Education.
- Tran, V. D. (2014). The effect of co-operative learning on the academic achievement, knowledge and retention. *International Journal of Higher Education*, 1(2), 1-6.
- Umaru, H. (2015). Effect of cooperative learning strategy on geography students' academic performance in senior secondary schools in Sokoto State, Nigeria. Unpublished M. Ed. dissertation, Ahmadu Bello University, Zaria.
- Wael, M. M. (2014). The effect of using cooperative learning strategy on graduate students' academic performance and gender differences. *Journal of Education and Practice*, 5(11), 64-71.