

# Efficacies Of Cooperative Learning Instructional Approach, Learning Activity Package, And Lecture Method In Enhancing Students' Academic Retention In Chemistry

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## ABSTRACT

This study assessed the efficacies of cooperative learning instructional approach (CLIA), learning activity package (LAP), and lecture method (LM) on enhancing students' academic retention in chemistry. Three research questions and three hypotheses guided this quasi-experimental study. The sample for the study was 194 students drawn from three schools using the balloting technique. The experimental groups were taught with CLIA and LAP, while the control groups were taught with LM by their regular chemistry teachers. Chemistry achievement/retention test, Cooperative Learning Operational Guide, and LAP Operational Guide were the instruments used for data collection in this study. Mean, standard deviation, and analysis of covariance were used in the analysis of the data collected. The study found that the CLIA and LAP enhanced students' academic retention in chemistry better than the LM. Furthermore, there was no significant difference in the academic retention between male and female students in chemistry. Recommendations from this study include cooperative learning strategies and learning packages in teaching chemistry.

**KEY WORDS:** chemistry; cooperative learning; gender; learning activity package; retention

## INTRODUCTION

### Background of the Study

Teaching and learning are important parts of the process of education which are aimed at, among other things, the development of learners' understanding and skills with which to become useful citizens in society. According to Akudolu (1994), teaching involves the setting up of activities to enable the child to learn something which improves their knowledge, skills, attitudes, and values. Similarly, Aggarwal (2007) stated that teaching is the deliberate and creative engagement of the learner in activities which facilitate their learning of worthwhile knowledge, skills, and attitudes. Learning is the acquisition of new behaviors or the strengthening or weakening of old behaviors as a result of experience. From the previous, it can be deduced that teaching and learning are vital tools that are needed for the overall development of the child, which is arguably the main objective of education. Meanwhile, instructional strategies are various ways through which teachers communicate and interact with students around academic content.

Bannon (2012) defined instructional strategies as ways in which information is made available to students. According to Nafees et al. (2012), the selection of the proper instructional delivery approach ensures the achievement of the stated

instructional objectives effectively. Furthermore, the selection of an appropriate instructional delivery approach portrays good teaching technique and facilitates successful learning. Therefore, the teacher should use a variety of instructional approaches to encourage students to develop critical thinking, problem-solving, and performance skills. This is because the way and manner in which the teacher gives instructions can either help or inhibit the student's ability to use various skills to think and solve problems. However, science teaching, specifically chemistry teaching, over the years has been approached mainly through traditional methods of delivery which do not allow the students the opportunity of experiencing other approaches to learning. For example, Cepni et al. (2006) highlighted that the use of traditional instructional approach in teaching only allowed students to understand the subject content at the knowledge level as they usually memorized the science concepts without understanding the real meanings. As a result, students do not conceptualize science very well. Furthermore, Wood and Gentile (2003) emphasized that there are better ways to learn that are now being recognized than through the traditional methods of instruction. They added that many of the traditional methods of conveying knowledge have been shown to be relatively ineffective on students' ability to master and then retain important concepts. Learning through these traditional methods of teaching is often

passive rather than active. These traditional methods (such as lecture, laboratory, and recitation) do not tend to foster critical and creative thinking or collaborative problem-solving (Olatoye et al., 2011). This might be a contributing factor to the poor academic retention of secondary school students in chemistry in Nigeria.

Chemistry as a very important science subject 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 (Jegade, 2007). Unfortunately, in Nigeria, research has shown that, despite the importance and centrality of Chemistry, students' academic performance in the subject is usually below expectation (Olatoye, 2008; WAEC, 2015). According to Salau (2002), many researchers have attributed poor performance in public examinations to the instructional delivery approaches adopted by many teachers. They noted that most teachers utilize the traditional instructional delivery approaches and that these do not encourage students' active participation in the lesson. The resultant effect is the low achievement and low retention level in students' outcome both in internal and external examinations. On the other hand, Nwagbo (2006) reported that high academic achievement is usually enhanced by proper instructional approach. Nevertheless, Okoye (2003) highlighted that instructional delivery approaches have also been known to influence students' academic retention. It is, therefore, necessary for the teachers to select and utilize instructional strategies that will ensure and enhance better academic retention of students in chemistry. It should be noted that students' retention of chemistry contents is highly facilitated by the utilization of those instructional strategies that will enable the students to participate actively in the lesson.

In their contribution, Lim and Morris (2009) pointed out that, as a result of the advancement in communication and network technologies, more innovative instructional delivery approaches have emerged to provide meaningful learning experiences for learners in academic settings. Therefore, classroom teachers must determine the most effective instructional strategy for their students. This study assessed two of such instructional strategies, Cooperative Learning Instructional Approach (CLIA) and learning activity package (LAP) as compared to the more traditional lecture method (LM).

## REVIEW OF RELATED LITERATURE

CLIA is a student-centered, instructor-facilitated instructional approach in which small groups of students are responsible for their own learning and the learning of all group members. Students interact with each other in the same group to acquire and practice the elements of a subject matter to solve a problem, complete a task, or achieve a goal (Alebiosu, 1998). In cooperative learning, small teams (groups), each with students of different levels of ability, use varieties of learning activities to improve the understanding of a subject (Hartman, 2002).

Here, each member of a team is responsible not only for their own learning but also for helping teammates learn, thus creating an atmosphere of achievement. Panitz (1999) added that, in a cooperative learning environment, the teacher maintains control of the learning environment, designs learning activities, structures work teams, but does not teach students. Sarah and Cassidy (2006) opined that cooperative learning required a small number of students to work together on a common task, supporting and encouraging one another to improve their learning through interdependence and cooperation with one another.

The cooperative learning group usually comprises two to five students which allows everyone to participate in a clearly designed task. Students within small cooperative learning groups are encouraged to share ideas and materials and to divide the work when appropriate to complete the task. Gillies (2004) affirmed that students benefit academically and socially from cooperative learning. According to Slavin (2011), cooperative learning develops in the students high-order thinking skills, improve interpersonal relations, as well as enhance motivation, and peer relations among students.

Various cooperative learning methods and models have been developed over the years by different scholars and put into actual practice in the classroom. Cooperative learning can be classified into two main categories: Structured team learning (STL) and informal group learning (IGL). Slavin (2011) added that STL involves rewards to teams based on the learning progress of their members. They are characterized by individual accountability, which means that team success depends on individual learning, not group products. STL includes such methods as Student Teams-Achievement Division (STAD), Teams-Games-Tournament, and Cooperative Integrated Reading and Composition. This study adapted the STAD method because it is most appropriate for teaching well-defined objectives, such as mathematical computations and sciences. On the other hand, IGL covers methods which are more focused on social dynamics, projects, and discussion than on mastery of well-specified content. These include Jigsaw (I), Jigsaw (II), Learning Together, think-pair-share, and group investigation. These methods are most appropriate in the teaching of arts and social science subjects and therefore were not included in this study.

Similarly, LAP according to Cardarelli in Neboh (2008) is student-centered but unlike CLIA is an activity-based teaching strategy where the teacher acts as a facilitator of learning and guides the students through series of activities and problems that may help them to achieve high academic retention. LAP is one of the approaches to learning which adjust to student needs and interests. The LAP follows a logical sequence of instructional objectives and activities which will help in achieving the stated objectives. In LAP, learning materials are broken into small steps that are arranged sequentially from known to unknown and in an increasing order of difficulty. It is a structured approach to individualization, leading the

student from the general idea to mastery of designated goals which in turn reinforce the general idea. More so, Ward and Williams (1976) stated that a LAP instruction clearly tells the student what to learn, suggests how to learn through a variety of learning resources, and determines whether the student has learned.

According to Arseneau (1994), LAP offers a very practical, successful method for individualizing instruction. It will help the students to assume more responsibility for their own learning and give them an opportunity to grow in self-discipline and self-motivation. In addition, it provides more occasions for genuine interaction between instructor and students. According to Ward and Williams (1976), most LAP consists of seven basic components/parts: Pre-test, performance objectives, concept, learning activities, self-test/evaluation, mastery/post-test, and enrichment opportunities. In Nigeria, the LAP being an innovative method of teaching can be utilized in the teaching and learning of chemistry by controlling some factors, such as good preparation and training of the teachers, provision of equipment/infrastructural facilities, and proper/adequate time allocation.

While empirical studies on CLIA and LAP have shown that both have been effective in enhancing students' academic retention in the science subjects better than the LM (Springer et al., 1999; Abu, 2000; Neboh, 2008; Anidu and Idoko, 2010; Olatoye et al., 2011; Christian and Pepple, 2012), these findings need to be further substantiated among Nigerian students. This necessitated this present study.

Furthermore, the influence of gender on students' academic retention has for a long time been of concern to many researchers. Some research has shown contradictory evidence in students' academic retention in sciences due to gender. For instance, Aluko (2005), Ifeakor (2005), and Udousoro (2000) found no significant difference in the academic retention of male and female students in chemistry. However, Jegede (2007) and Lawal (2009) found a significant difference in the academic retention of male and female students in chemistry. Specifically, Okoro (2011) found that females performed better than males when taught using cooperative learning. However, when the students were taught using competitive or individualized teaching strategy, the male students' performance was better than that of their female counterparts. The inconsistent results on gender generated the need for further study. Moreover, evidence from available literature reviewed by the researcher shows that no conclusion has been reached on the influence of gender on students' academic retention when taught with three teaching strategies. Therefore, the focus of this study is to find the interactive effect if any of CLIA, LAP, and LM on gender as a social construct on students' academic retention in chemistry.

### Purpose of the Study

The purpose of this study was to assess the efficacies of instructional approaches CLIA and LAP as compared to traditional LM in enhancing senior secondary school students'

academic retention in chemistry. Specifically, this study sought to address the following:

1. What is the effectiveness of CLIA, LAP, and LM in enhancing students' academic retention in chemistry?
  - Hypothesis - CLIA, LAP, and LM did not significantly increase students' retention in chemistry.
2. What is the academic retention difference, if any, between male and female students taught using CLIA, LAP, and LM?
  - Hypothesis - there was no significant difference in the academic retention between males and females taught using CLIA, LAP, and LM.
3. What is the interaction effect, if any, of method and gender on students' academic retention in chemistry?
  - Hypothesis - there was no interaction effect of method and gender on students' academic retention in chemistry.

## MATERIALS AND METHODS

The study employed a pre-test, post-test, non-equivalent, control group, quasi-experimental design. The study area was the Afikpo Education Zone of Ebonyi State, Nigeria. The population comprised 1410 senior secondary class two (SS2) chemistry students in all the government coeducational secondary schools in the area in the 2016/2017 academic year. A sample of 194 students (108 males and 86 females) was randomly drawn from three schools in the educational zone based on availability of three class streams, coeducational, the teacher having taught chemistry for more than 10 years, and the number of students in each class not exceeding 40. In each of the sampled schools, the teacher separated the three class streams into CLIA, LAP, and LM groups/classes, teaching them with the designated strategy for each group/class.

The study used three instruments: Chemistry achievement/retention test (CART), Cooperative Learning Operational Guide (CLOG), and LAP Operational Guide (LAPOG). The CART was a researcher-made 25-item multiple choice test, which was developed using a table of specification to determine the number of test items for each topic along three categories of cognitive objective: Knowledge (remembering), comprehension (understanding), and application (thinking), with eleven, eight, and six questions, respectively. Each test item had four response options A–D with only one option as the correct answer while others were distracters. The CART was a final version of an item analysis carried out on a 40-item pilot instrument. The final 25 items were selected as they all had a difficulty indices that ranged between 0.40 and 0.60 and possessed positive item discrimination index of +0.30 and above and a positive distracter index.

The CLOG was constructed by the researcher using the STAD method of cooperative learning. Similarly, the LAPOG was created by the researcher. It was adapted from the works of Ward and Williams (1976). Both the CLOG and LAPOG contained the following topics in organic chemistry: Structure and valency of carbon, hydrocarbons, homologous series, saturated and unsaturated hydrocarbons, and isomerism.

The three instruments were validated by science education experts in the Faculty of Education, Enugu State University of Science and Technology, Enugu. The CART was pilot-tested on 40 SS2 chemistry students outside the study area to determine the internal consistency and stability using Kuder–Richardson formula 20 and Pearson's product moment with indices of 0.82 and 0.94, respectively. The CLOG and LAPOG were pilot-tested on separate students during the training of the participating teachers. This enabled the researcher to identify and clarify all the areas that needed clarifications. The entire duration of the study was 4 weeks. The CART was administered to both experimental and control groups as pre-test to measure their initial levels of achievement before the treatment commenced. In the CLIA, the students were assigned to 5-member learning teams. Each team was a microcosm of the entire class, comprising high-, average-, and low-performing students (determined using their pre-test scores) as well as a mix of boys and girls. Furthermore, in the LAP, each student carried out the required activities as contained therein and progressed at their own pace. However, the control groups were taught using the conventional LM.

At the end of the 4 weeks, the post-test was administered, and after further 2 weeks, the retention test was administered. The CART was used for the three tests (pre-test, post-test, and retention test). The questions were reshuffled in each test to make it look different at face value. The data collected were analyzed using both descriptive and inferential statistics. The research questions were answered using mean with standard deviation, while the analysis of covariance (ANCOVA) was used to test the null hypotheses. These were calculated using Statistical Package for the Social Sciences (SPSS). Furthermore, efforts were made by the researcher to control extraneous variables such as teacher effect, subject interaction, Hawthorne effect, and intergroup variable. For instance, to control subject interaction, the teachers ensured that there were different lessons going on simultaneously in other SS2 classes. This reduced wandering of the students and prevented distractions.

## RESULTS

The results of the study are presented below. The data obtained from the administration of the CART to the experimental and control groups were analyzed according to the research questions and hypotheses.

### Comparison between CLIA, LAP, and LM

Research question 1: What is the effectiveness of CLIA, LAP, and LM in enhancing students' academic retention in chemistry?

Table 1 shows that the total pre-test mean scores of the male and female students taught with CLIA, LAP, and LM were 10.30, 10.25, and 10.15, respectively. Thus, the three groups were similar at the beginning of the experiment. From Table 1, the CLIA group had a total mean retention score of 31.24 with a standard deviation of 3.15. The LAP group had a total

**Table 1: Mean scores and standard deviations of the groups in the pre-test, post-test, and retention test**

Test	Group	Gender	Mean±SD	n*	
Pre-test score	CLIA	Male	10.63±3.34	37	
		Female	9.98±3.50	31	
		Total	10.30±3.41	68	
	LAP	Male	9.71±4.12	41	
		Female	11.01±3.58	29	
		Total	10.25±3.90	70	
	LM	Male	10.22±3.60	30	
		Female	10.07±3.31	26	
		Total	10.15±3.47	56	
	Total	Male	10.17±3.71	108	
		Female	10.35±3.47	86	
		Total	10.25±3.60	194	
Post-test score		CLIA	Male	29.80±2.84	37
			Female	31.72±3.02	31
			Total	30.68±2.92	68
	LAP	Male	31.10±3.07	41	
		Female	30.44±2.91	29	
		Total	30.83±3.00	70	
LM	Male	18.01±2.95	30		
	Female	17.59±3.03	26		
	Total	17.80±3.00	56		
Total	Male	27.02±2.91	108		
	Female	27.02±2.98	86		
	Total	27.02±2.94	194		
	Retention test score	CLIA	Male	30.64±3.20	37
			Female	31.95±3.10	31
			Total	31.24±3.15	68
LAP		Male	31.80±3.00	41	
		Female	30.78±3.04	29	
		Total	31.38±3.01	70	
LM		Male	17.60±2.86	30	
		Female	17.48±3.02	26	
		Total	17.54±2.94	56	
Total		Male	27.46±3.03	108	
		Female	27.18±3.06	86	
		Total	27.34±3.04	194	

\*Where *n* is the number of subjects, CLAP: Cooperative learning instructional approach, LAP: Learning activity package, LM: Lecture method

mean retention score of 31.38 with a standard deviation of 3.01, while the LM group had a total mean retention score of 17.54 with a standard deviation of 2.94. However, Table 1 does not indicate whether the observed differences in the mean retention scores of the three groups in the retention tests were significant. Hence, the results were subjected to inferential testing as shown in hypothesis 1.

Hypothesis 1: CLIA, LAP, and LM did not significantly increase students' retention in chemistry.

Table 2 shows that the strategy used had significant effects on the students' academic retention in chemistry as  $F(2, 194) = 5.703, p < 0.05$ . The null hypothesis was, therefore, rejected. This implies that the instructional strategies CLIA, LAP, and LM were effective in enhancing students' academic

**Table 2: ANCOVA of students' overall retention scores by teaching method and gender**

Source of variation	Type III sum of squares	Df	Mean square	F-cal	p-value	Decision
Corrected model	729.681	2	364.840	5.703	0.003	S
Intercept	111003.743	1	111003.743	1735.195	0.000	S
Method	729.681	2	364.840	5.703	0.003	S
Gender	87.990	1	87.990	1.395	0.239	NS
Method X gender	107.193	2	53.597	0.898	0.091	NS
Error	10841.485	191	56.761			
Total	12664.001	194	65.278			
Corrected total	15571.166	194	80.264			

ANCOVA: Analysis of covariance

retention in chemistry. Having established effectiveness of the three instructional strategies, a *post hoc* analysis using Scheffe's test was conducted to determine the direction of the effectiveness among the three instructional strategies as shown in Table 3.

From Table 3, the Scheffe's *post hoc* analysis shows that there was no significant difference between CLIA and LAP ( $\rho$ -value = 0.447,  $\rho > 0.05$ ). However, there was a significant difference between CLIA and LM ( $\rho$ -value = 0.034,  $\rho < 0.05$ ). Furthermore, there was a significant difference between LAP and LM ( $\rho$ -value = 0.022). This, therefore, means that CLIA and LAP were significantly more effective than the LM.

### Academic Retention and Gender

Research question 2: What is the academic retention difference, if any, between male and female students taught using CLIS, LAP, and LM?

From Table 1, it can be seen that, in the CLIA, the mean retention gain scores of the male and female students were 30.64 and 31.95 with standard deviations of 3.20 and 3.10, respectively. This indicates that the female students had a higher academic retention than their male counterparts. Similarly, in the LAP, the mean retention gain scores of the male and female students were 31.80 and 30.78 with standard deviations of 3.00 and 3.04, respectively. This highlights that the male students had a higher academic retention than their female counterparts. On the other hand, in the LM, the mean retention gain scores of the male and female students were 17.60 and 17.48 with standard deviations of 2.86 and 3.02, respectively. This points to the fact that the male students had a higher academic retention than their female counterparts. Table 4 indicates that there were slight differences in the mean retention gain scores of the male and female students taught with CLIA, LAP, and LM. However, Table 1 does not show whether the observed differences are significant. To ascertain whether the observed differences were significant or could be attributed to error variance, the results were subjected to inferential testing as shown in hypothesis 2.

Hypothesis 2: There was no significant difference in the academic retention between males and females taught using CLIA, LAP, and LM.

Table 2 shows that  $F(1,194) = 1.395$ ,  $\rho > 0.05$ . Therefore, the

**Table 3: Pair-wise comparison of the three groups using Scheffe's test**

(I) Treatment	(J) Treatment	Mean difference (I-J)	SE	p-value
CLIA	LAP	4.60	1.221	0.447
	lecture	6.50	1.345	0.034
LAP	CLIA	-4.60	1.221	0.447
	lecture	9.00	1.731	0.002
Lecture	CLIA	-6.50-9.00	1.345	0.034
	LAP		1.731	0.002

CLAP: Cooperative learning instructional approach, LAP: Learning activity package

null hypothesis fails to be rejected. This implies that there was no significant difference in the retention test scores of the male and female students. This means that the efficacies of the teaching methods were not influenced by the students' gender.

### Interaction Effect between Methods and Gender

Research question 3: What is the interaction effect, if any, of method and gender on students' academic retention in chemistry?

Table 4 revealed that the male students taught chemistry with CLIA had a mean retention score of 30.64, while the females had a mean retention score of 31.95. This shows that CLIA interaction with gender had more effect on the female students than on the male students. Furthermore, the males taught with LAP had a mean retention score of 31.80, while their female counterparts had a mean retention score of 30.78. Hence, LAP was more effective on the male students than on the females. Similarly, the male students taught that chemistry using LM had a mean retention score of 17.60 while the female students had mean retention score of 17.48. This shows that LM was slightly more effective on the male students than on the female students. However, Table 4 does not show whether the differences observed are significant or can be attributed to error variance. Therefore, the result was subjected to inferential testing as shown in hypothesis 3.

Hypothesis 3: There was no interaction effect of method and gender on students' academic retention in chemistry.

In Table 2,  $F(2, 194) = 0.898$ ,  $\rho > 0.05$ . The null hypothesis was therefore not rejected. This shows that there was no significant interaction effect of method and gender on students' academic retention in chemistry. Hence, the two-way interaction of

**Table 4: Mean and standard deviation scores of interaction effect between methods and gender on students' academic retention**

Dependent variable	Group	Gender	Mean $\pm$ SD	95% confidence interval	
				Lower bound	Upper bound
Retention score	CLIA	Male	30.64 $\pm$ 0.526	29.609	31.671
		Female	31.95 $\pm$ 0.557	30.858	33.042
	LM	Male	31.80 $\pm$ 0.469	30.881	32.719
		Female	30.78 $\pm$ 0.565	29.673	31.887
		Male	17.60 $\pm$ 0.522	16.577	18.623
		Female	17.48 $\pm$ 0.592	16.314	18.646

CLIA: Cooperative learning instructional approach, LAP: Learning activity package

method and gender has no significant effect on students' academic retention in chemistry.

## DISCUSSION

Results of data analysis have shown that the instructional strategies such as CLIA, LAP, and LM were effective in enhancing students' retention in chemistry. This finding agrees with the findings of Springer et al. (1999) and Olatoye et al. (2011), who in their separate studies found that the teaching method had significant effects on students' academic retention in chemistry. Meanwhile, further independent interpretations of both descriptive statistics and ANCOVA showed that the students taught with CLIA and LAP had a higher academic retention than their counterparts in LM. This finding agrees with the findings of Springer et al. (1999), Abu (2000), Neboh (2008), Anidu and Idoko (2010), and Christian and Pepple (2012) that the CLIA and LAP were more effective than LM in enhancing students' academic retention in chemistry, biology, and science. Moreover, the relative effectiveness of CLIA and LAP over LM in enhancing students' academic retention could be attributed to the fact that both CLIA and LAP were student centered and activity based. In the CLIA and LAP, all sense organs and other parts of the students' body were involved in the learning process. The students were guided by their teachers to discover knowledge and take control of their study in the class. These instructional approaches were different from LM in which students were more often passive recipients of facts from their teacher. Given these prevailing circumstances under which these instructional strategies were employed in the classrooms, it is not surprising that the students taught with CLIA and LAP had higher academic retention than their LM counterparts.

Meanwhile, the findings of this study on gender revealed that no significant difference existed in the mean retention scores of male and female students in chemistry. This finding agrees with the findings of Iloputaife (2001) and Oludipe (2012) who found no significant difference in male and female students' academic retention in chemistry, biology, and science. However, the findings disagree with the findings of Ugwu (2007), Lawal (2009), and Bosede (2010) that there was a significant difference in the male and female students' academic retention in biology, chemistry, and science. This

study confirms the research that gender has no significant influence on students' academic retention when taught with student-centered and activity-based instructional strategies.

Furthermore, this study established no significant interaction effect of method and gender on students' academic retention in chemistry. This agrees with the findings of Iloputaife (2001) and Adekoya and Olatoye (2011) that there is no interaction effect of method and gender on students' academic retention. However, on the contrary, the finding disagrees with the findings of Ezeudu (2013) that there was a significant interaction effect of method and gender on students' academic retention. The fact that this study found that no significant interaction effect of method and gender on students' academic retention in chemistry supports the research that methods do not depend on students' gender to be effective.

### Educational Implications of the Study

As stated, research studies have shown that students' academic retention in chemistry has been poor. The major cause of the poor academic retention could be attributed to among other things, such as the use of inappropriate/less effective teaching methods by the chemistry teachers. This present study found that the CLIA and LAP were more effective than LM in enhancing students' academic retention in chemistry. Therefore, this study lends empirical support to the fact that students' academic retention in chemistry could be greatly improved if they are exposed to innovative, student-centered, and activity-based instructional strategies.

Moreover, this study also found no significant difference in the academic retention of male and female students in chemistry. In addition, this study found no interaction effect of method and gender on students' academic retention. Based on the findings of this study, it can be concluded that, when teachers utilize CLIA and LAP in teaching chemistry, students' academic retention will most likely be improved.

Furthermore, the findings of this study have shown that CLIA and LAP were more effective in enhancing students' academic retention than LM which has been adopted by many chemistry teachers in Nigerian secondary schools. The academic retention of students in chemistry would be improved if students were exposed to varieties of student-centered and activity-oriented instructional strategies such as CLIA and LAP. Furthermore,

when CLIA and LAP are integrated into Nigerian classrooms, they would assist to produce better academic retention of students in science and in chemistry, in particular. These would not only help to restore chemistry's educational value and relevance to the needs of the students but also the needs of society.

In addition, the link between chemistry and everyday life as emphasized in the Federal Ministry of Education (2009) will be realized with the utilization of instructional strategies such as the CLIA and LAP where students not only engage in classroom activities but also attempt to solve similar problems in the environment and graduates to the level of solving more complex real-life problems for the good of the society. The use of CLIA and LAP instructional strategies in chemistry classrooms would serve as motivation to the students which could encourage them to attend classes and participate actively in the lessons.

Meanwhile, with CLIA and LAP, the spirit of cooperation, learning together, and comparing notes in the learning process are being encouraged, and the students now see themselves as partners instead of co-competitors. These resulted in the effectiveness of the instructional strategies which have now positioned the strategies on a good pedestal for adoption in the teaching of science subjects in the Nigerian secondary schools.

Based on the findings of this study, the researcher makes the following recommendations:

1. Chemistry teachers should expose their students to CLIA and LAP as these strategies promote and encourage social interaction and active learning by experience among learners leading to enhanced academic retention.
2. The secondary school chemistry teachers should be encouraged to embark on regular training and retraining on the effective use of CLIA and LAP in the classroom.
3. The education stakeholders, especially, curriculum planners, State and Federal Ministries of Education should advocate for the inclusion of CLIA and LAP in the chemistry curriculum for effective teaching and learning in the secondary schools.
4. Specifically for the Nigerian context, The Science Teachers' Association of Nigeria should include these instructional strategies in its regular subject panel workshops across the country to equip teachers with the necessary knowledge and skills for using the strategies effectively.

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