

*Full Length Research Paper*

# Impact of Contemporary Learning Strategies on Chemistry Students' Performance and Retention in Rivers State

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Received: 1 April, 2021, Accepted: 16 April, 2021, Published: 20 April, 2021

The main purpose of this study was to investigate the effect of contemporary learning strategies such as collaborative and individualized learning strategies on students' performance and retention in organic chemistry in Rivers State. A quasi-experimental design was adopted. Through purposive sampling technique two schools were selected and randomly assigned to the experimental and control groups. 115 students were involved in the study with 70 students in the experimental group and 45 students in the control group. Three research questions and three hypotheses guided the study. The instrument for data collection was a teacher-made test tagged Chemistry Achievement Test which consisted of twenty-five (25) multiple-choice objective test items on General Ability Test on Organic Chemistry (GATOC) constructed by the researcher. The instrument was validated by experts in Science Education and Chemistry evaluators. The instrument had a reliability coefficient of  $r = 0.78$  using a test-retest method of estimating reliability. Both groups were presented with a pretest (CAT) then after, the experimental group was taught organic chemistry with the collaborative learning method while the other group was taught using the individualized learning strategy. Both groups were thereafter post tested with CAT. The data obtained were descriptively analyzed using mean and standard deviation for the research questions, while independent t-test and ANCOVA were used for the hypotheses which were tested at 0.05 level of significance. The results showed that both male and female students taught organic chemistry using, collaborative learning strategy (CLS) performed better than the group taught using individualized learning strategy (ILS). And that there was no significance difference between male and female performance in both collaborative and individualized learning strategies. In addition, the study also found out that there is no significant interactive effect of learning strategies and gender on students' performance and retention in organic chemistry. Based on the findings, it was recommended that teachers of chemistry should intensify effort to ensure that students of chemistry participate in group learning (collaborative) for better understanding of organic chemistry concepts and retention.

**Key words:** Contemporary, Collaborative and individualized, learning strategies, chemistry, retention

## INTRODUCTION

The development of any nation depends largely on the level of scientific and technological literacy possessed by the citizenry (Ivovoi, 2003) in Shedrack & Robert (2016). The question what on earth is not chemistry as reported in (international charter chemist of Nigeria)

(ICCON, 2018) has remained on enigma since 1998. According to Hill (2018) Chemistry is so inclusive that it serves as a pre-requisite to the study of all science based disciplines. It is in light of the above, the subject Chemistry was introduced in Nigerian secondary schools at senior level. The aim of teaching Chemistry in secondary school is to bring about the technological development needed by the nation through the production of young scientists who would be able to

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produce the technological devices to ease our daily activities and livelihood satisfactory (FRN 2007). Chemistry is learnt at the post primary level in order to achieve the following objectives.

- (a) To devise ways to improve life condition
- (b) To devise ways of utilizing natural substances and creation of artificial ones
- (c) To acquire certain scientific skills and attitude as preparation for technological application of chemistry
- (d) To provide basic literacy in Chemistry for functional living in the society
- (e) To acquire basic concepts of chemistry as a preparation for further studies.

Regrettably these aims and objectives of chemistry are not been achieved as purpose in Nigeria due to a number of factors such as teaching strategies employed by chemistry teachers, chemistry teachers should employ means and utilize effective teaching strategies to arouse the interest of students in chemistry which will subsequently improve their performance in chemistry examinations such as National Examination Council (NECO) and Senior Secondary School Examination (SSCE). It has been observed that the undesirable state of science education in the nation is as a result of the excessive use of the traditional strategy been adopted by most science teacher. (Osinubi, 2013; Ezeliora, 2014). The subject, chemistry is one of the basic requirements for admission into university and polytechnics to ready some professional courses like medicine pharmacy, biochemistry etc. But poor background of students in chemistry as a matter of poor teaching strategy and the inability of chemistry teachers involves using appropriate contemporary learning strategies such as collaborative and individualized learning strategies to enhance student's performance in chemistry.

From the observation, there is need to explore other contemporary learning strategies such as collaborative and individualized learning strategies to enhance students understanding of what they have being taught and equally handle the problem of poor performance in chemistry collaborative and individualized important qualities that empower them quite necessary for instruction collaborative learning strategy is an interaction between individuals who are responsible for their own learning and able to work with their peers with respect to their contributions (Chandra, 2015). Collaborative learning strategy is characterized by interdependence, person responsibility and accountability. Members share authorities and small group learning member leans from personal backs during exchange of ideas. Collaborative learning strategy is a team process where members support and rely on each. Other to achieve an agreed-upon goal (Barkely, Cross & Howell major 2005) in Arokoyu & Nduudee (2018).

Furthermore, collaborative learning strategy impact on

students on students learning by helping students to developed higher level thinking, oral communication, self-management and leadership skills. Collaborative learning is beneficial to students through celebration of diversity in since students developed the habit of working with all types of people, it also acknowledge individual different question raising people different students gives variety of responses. Collaborative learning promotes interpersonal development.

Finally, on the other hand, individualized instructional strategy according wikipedia (2014) is a method of instruction in which content, instructional technology (such as material) and pace of learning are based upon abilities and interests of each individualized strategy is hinged on students completing units of work at their pace before moving on to more complex units of tasks individualized learning strategies is based on the purpose of;

- To enhance and develop listening habit
- It allows each student to progress through the curriculum at his or her own pace.
- Long term retention as they note down what they usually understand
- Importance is given to a child as an individual not as a group or class.

Some research work that has investigated on either of the two learning strategies or both in relation to students performance as reported in literature included that of Adolphus (2012) who found out that students taught with collaborative learning approach understood better than those taught with demonstration approach and that gender does not significantly affect the understanding of students in electromagnetic induction when taught with collaboration or demonstration approach. In the same vein, Alavi, (1994) investigating the use of a group decision support system (GDSS) in a collaborative learning process to enhance student learning and evaluation of classroom experiences in Nandi District of Kenya and found out that GDSS supported collaborative learning evaluation of classroom experience than non-GDSS. In addition, the final test grades of the group of students who were exposed to GDSS-supported collaborative learning were significantly higher than those of the other group of students who participated in the experiment. In 2004, Pepple investigated the effects of collaborative learning and individualized instruction on students' achievement in chemistry in senior secondary schools in Port Harcourt City Local Government Area of Rivers State. The findings of the study indicated that there was a significant main effect of the treatment on the achievement of students in chemistry, also there was significant main effect of mathematical ability on students' achievement in chemistry. However, there was no significant main effect of gender on achievement of students in chemistry. Other research works are those of

**Table 1:** Illustration of Pretest-posttest control group quasi-experimental design

Group	Pretest	Treatment	Posttest
Experimental	O1	X	O2
Control	O3		O4

Where O1 and O3 = Pretest scores, O2 and O4 = Posttest scores, X = Treatment

David, Michael, Hannafin and Simon (2010); Abdulsalem and Salf (2012).

Chemistry and especially Organic chemistry is one of the perceived difficult concepts by both students and teachers in senior secondary chemistry. Experience has shown that the adequate and efficient use of the right learning and teaching strategies enhances the learning and teaching of science hence the method adopted in the learning of science particularly chemistry is an essential ingredient for smooth and successful growth and development (Okebukola, 2002).

In a classroom setting, if students are involved in only passive learning, it would lead to limited knowledge retention, let alone engaging them in thinking or promoting functional understanding. Research works have shown that involving students directly and actively in the learning process promotes meaningful learning (Peter, Abiodun, & Jonathan, 2010). However, a teaching-learning process which makes the learners passive and inactive directly or indirectly affects their performance negatively. Evidence is shown in the results of students presented by both NECO and WAEC every year. The poor performance rate is not acceptable if Nigeria is to move forward industrially. The failure rate is indeed a problem and a course of concern to all stakeholders in the educational sector.

Consequently, the problem of this study is what is the effect of collaborative and individualized learning strategies on student's performance and retention in organic chemistry in Rivers State? To resolve this research problem, the following research questions were posed and answered in this study:

1. What is the effect of collaborative learning strategy on male and female students' performance and retention in organic chemistry?
2. What is the effect of individualized learning strategy on male and female students' performance and retention in organic chemistry?
3. What is the joint effect of learning strategies and gender on students' performance and retention in organic chemistry?

To answer these research questions the following null hypotheses were formulated as tentative answers to the research questions and further tested at 0.05 level of significance.

- i. There is no significant difference in the mean score of male and female students' performance and retention

in organic chemistry when exposed to collaborative learning strategy.

- ii. There is no significant difference in the mean score of male and female students' performance and retention in organic chemistry when exposed to individualized learning strategy.
- iii. There is no significant interaction effect of learning strategies and gender on students' performance and retention in organic chemistry.

## METHODOLOGY

This study adopted the pre-test, post-test, control group quasi-experimental design. An illustration of the design is presented on Table 1. The population of the study consisted of all senior secondary school two (SSII) students of chemistry in four public co-educational secondary school totaling 200 in Eleme Local Government Area of River State. Through purposive sampling technique two schools were selected and randomly assigned as experimental and control group. It should be noted that each group served as control group to each other depending on the learning strategy of interests. The SSII intact class of each of the selected schools was used. The class assigned to collaborative learning had 70 students while the individualized learning group had 45 students. Hence, 115 students constituted the sample of the study. The instrument for the study was a researcher constructed and validated teacher made test, named Chemistry Achievement Test (CAT) based on the content of instruction for SSII. The instrument consists of two parts, A and B. Part A, covers learners personal data, part B was a twenty-five (25) multiple-choice objective test items with option A to D. The reliability coefficient of the instrument was 0.78, established through test-retest method of estimating reliability as a measure of its stability over time.

The pretest-CAT was administered to the sample in their intact classes in the selected schools to establish the equivalence of the subjects for the study. The normal school period for chemistry was used for the study. This was three periods per week of 40 minute/period for two (2) weeks. After the treatment for two weeks, the students were subjected to the same post-test CAT. The post-test contains the same questions only the items were reshuffled in numbering and slightly reframed. The chemistry teachers of the sampled schools were trained and properly guided to serve as research assistance(s). The data collected were analyzed through mean, and

**Table 2:** t-test analysis of the effect of collaborative learning strategy on male and female students' performance and retention in organic chemistry

Variables	Gender	N	Mea	SD	df	t	Sig
Retention	Male	37	65.47	12.86	68	2.004*	.049
	Female	33	68.71	12.76			
Pretest	Male	37	42.31	14.58	68	0.294	.769
	Female	33	38.08	9.31			
Posttest	Male	37	72.38	11.09	68	0.314	.314
	Female	33	68.98	10.61			

\*Significant,  $p < 0.05$  level of significance

**Table 3:** t-test analysis of the effect of individualized learning strategy on male and female students' performance and retention in organic chemistry

Variables	Gender	N	Mea	SD	df	t	Sig
Retention	Male	25	52.70	1.99	43	0.463	.498
	Female	20	52.40	2.81			
Pretest	Male	25	31.40	2.17	43	0.061	.805
	Female	20	36.80	3.06			
Posttest	Male	25	61.73	1.81	43	3.366	.069
	Female	20	59.47	2.56			

NS = Not Significant,  $p > 0.05$  level of significance

standard deviation for the research questions and t-test and Analysis of covariance (ANCOVA) for the hypotheses.

## RESULTS

Research question 1: What is the effect of collaborative learning strategy on male and female students' performance and retention in organic chemistry?

Hypothesis 1: There is no significant difference in the mean score of male and female students' performance and retention in organic chemistry when exposed to collaborative learning strategy.

To answer this research question and test its corresponding hypothesis, independent t-test statistic was employed and the result presented in Table 2.

Table 2 shows that the mean score for the pretest for male and female were 42.31 and 38.08 respectively while posttest were 72.38 and 68.98 and retention was 65.47 and 68.71 respectively. This implies that male students mean score was higher than that of their female counterpart both in pretest and posttest but, that of female was higher in retention. On further statistical testing only the t-value for retention was found to be significant,  $df = 68$  at 0.05 level of significance. The null hypothesis is therefore accepted with respect to students' performance but rejected with respect to retention. The result shows that there is no significant difference in the

mean score of male and female students' performance in organic chemistry when exposed to collaborative learning strategy.

Research question 2: What is the effect of individualized learning strategy on male and female students' performance and retention in organic chemistry?

Hypothesis 2: There is no significant difference in the mean score of male and female students' performance and retention in organic chemistry when exposed to individualized learning strategy.

To answer this research question and test its corresponding hypothesis, independent t-test statistic was deployed and the result presented in Table 3.

Table 3 shows that the mean score for the pretest for male and female were 31.40 and 36.80 respectively while posttest were 61.73 and 59.47 and retention was 52.70 and 52.40 respectively. This implies that male students mean score was higher than that of their female counterpart both in retention and posttest but, that of female was higher in pretest. On further statistical testing none of the t-values was found to be significant,  $df = 43$  at 0.05 level of significance. The null hypothesis is therefore accepted. The result therefore is that there is no significant difference in the mean score of male and female students' performance and retention in organic chemistry when exposed to individualized learning strategy.

Research question 3: What is the joint effect of learning

**Table 4:** Interaction effect of learning strategies and gender on students' performance and retention in organic chemistry

SV	DV	SS	df	MS	F
LS	Retention	5366.675	1	5366.675	45.260*
	Pretest	943.297	1	943.297	6.703*
	Posttest	2194.722	1	2194.722	22.329*
GENDER	Retention	54.923	1	54.923	.463
	Pretest	8.635	1	8.635	.061
	Posttest	330.892	1	330.892	3.366
LS*GENDER	Retention	79.612	1	54.923	.463
	Pretest	588.994	1	588.994	4.185*
	Posttest	45.832	1	45.832	.466
Error	Retention	13161.685	111	118.574	
	Pretest	15621.238	111	140.732	
	Posttest	10910.363	111	98.292	
Total	Retention	454227.000	115		
	Pretest	177905.000	115		
	Posttest	518638.000	115		

\*Significant,  $p < 0.05$  level of significance

SV = Source of Variation

DV = Dependent Variables

LS = Learning Strategies (Collaborative and Individualized)

strategies and gender on students' performance and retention in organic chemistry?

Hypothesis 3: There is no significant interaction effect of learning strategies and gender on students' performance and retention in organic chemistry.

To answer this research question and test the corresponding hypothesis, a 2 X 2 analysis of covariance (two-way ANCOVA) was applied to the relevant data collected. This is because there are two independent variables (learning strategies with two levels, collaborative and individualized as well as gender which also have two levels, male and female students. The results are presented in Table 4.

In Table 4, LS\*Gender indicates the interaction between the learning strategies and gender which is the main concern of this hypothesis. The calculated F-ratio ( $F_{(1, 111)} = .466$ ) which is not significant, since  $p > 0.05$  level of significance. The null hypotheses which states that there is no significant interaction effect of learning strategies and gender on students' performance and retention in organic chemistry, is therefore, accepted.

## DISCUSSIONS

The study was concerned with the effects of learning strategies (collaborative and individualized) on students' performance and retention in organic chemistry in Rivers State using senior secondary school two (SSS II) chemistry students in two secondary schools in Eleme Local Government Area of Rivers State.

It was revealed that gender do not significantly affect students' performed in both collaborative learning strategy and individualized learning strategy. In addition, the interaction effect of learning strategies and gender was also found not to be significant. These findings are

however dissimilar to earlier findings made by Adolphus (2012), Alavi (1994), David, Micheal Hannafin and Simon (2010) and Abdulsalem and Salf (2012) who in their separate research found out that students achievement in collaborative learning group was significantly higher than that of the traditional learning group based on gender.

## CONCLUSION AND RECOMMENDATIONS

From the findings, it could be concluded that both learning strategies impact positively on students' performance and retention in organic chemistry but not on the basis of gender. Consequently the following are recommended:

1. Teachers of chemistry should encourage students to participate in group learning for better understanding and retention.
2. Chemistry students should cultivate the habit of collaborative learning strategy and individualized learning strategy in learning chemistry concepts in the secondary schools as they are found to positively improve students' development and discovery of new concepts.
3. Chemistry curriculum planners should integrate the collaborative and individualized learning strategies into the curriculum as learning strategies since both strategies aids retention of the concepts in organic chemistry.

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