



Effect of Co-operative Learning Strategy on Chemistry Student's Academic Achievement in Kaduna State

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ABSTRACT

This quasi-experimental study investigated the impact of a cooperative learning strategy on chemistry students' academic achievement at the Senior Secondary School (SSS) level in Sabon Gari LGA of Kaduna State. A descriptive survey and Quasi-experimental design method were adopted for this research. The population of the study comprises all SSS chemistry students in the six public schools in Sabon Gari L. G. A. (4109). Two schools were used for the experimental (40 students) and control (40 students) groups. The control group was taught separation techniques using the conventional lecture method while the experimental group was taught the same using the cooperative learning strategy for 4 weeks. The instrument used for collecting data is the Chemistry Assessment Test (CAT) and the research questions raised were answered using means and standard deviations while the null hypotheses were tested at $P \leq 0.05$ using t-test statistics. Results showed that the Co-operative learning strategy had a significant impact on the performance of pupils than the conventional lecture method ($P < 0.05$). Also, there was no significant difference between the mean scores of male and female pupils in this study ($P > 0.05$). Based on these findings, it was recommended that Co-operative Learning Strategy may be a useful scaffold in teaching chemistry in senior secondary schools which will consequently enhance learning.

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INTRODUCTION

Chemistry is one of the important science subjects taught at the Senior Secondary School (SSS) level. It is one of the core science subjects that students are required to pass at credit level to qualify for admission into tertiary institutions to pursue science-based programs. Despite this central and important position of Chemistry among other science and related disciplines, studies revealed that the academic achievement of students in Chemistry in the Senior Secondary School Certificate Examination (SSSCE) has consistently been very poor and unimpressive (Njoku, 2012). Many factors have been suggested as contributing to the poor performance of students in Chemistry and science in general. Some of these factors include inadequate laboratory equipment in Chemistry

(Eniayeju, 2010); poor teaching methods (Ayogu, 2015); mathematical nature of Chemistry among others.

Balancing chemical equations is one of the difficult concepts chemistry students encounter in both practical and theory. The concept of balancing chemical equations has been recognized as one of the basic chemical concepts in chemistry, as suggested by Ababio, (2011). Anthony (2009) reported that understanding the basic chemistry concept is a prerequisite to the comprehension of some learning tasks in chemistry such as chemical equilibrium, electrochemistry and organic chemistry. This is supported by WAEC chief examiners' reports of 2009, 2010, and 2011, which ascertained that what made most Chemistry students perform poorly in Chemistry,

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was the inability of the students to write correctly, reactants, and products as well as to balance the reaction equation correctly. Therefore, there is a need to find a way of solving this problem.

Several activity-oriented instructional strategies have been advocated for by curriculum designers and science educators (Eniayeju, 2015) in Dahiru (2013) to help improve the failure rate among secondary school science students. Examples of these strategies include the guided discovery approach, demonstration method, discussion method and problem-solving for teaching senior secondary school Chemistry as stipulated in National Policy on Education (NPE, 2012). Research findings had, however, revealed that to date, a large proportion of science teachers, Chemistry inclusive, still resort to the use of traditional/lecture methods rather than the activity-oriented or student-centred strategies advocated for, such as demonstration method, problem-solving and others (Olorukooba, 2015). For the concepts in Chemistry to be taught effectively to Chemistry students in secondary schools, Cooperative learning has been considered relevant and fruitful (Lyman & Harvey, 2017). Co-operative learning is a teaching strategy involving students' participation in small group learning activities that promote positive interaction. Tinzmann (2013) observe that classrooms have four general characteristics. The first two capture changing relationships between teachers and students, the third characterizes teachers' new approaches to instruction and the fourth addresses the composition of a Cooperative classroom.

Co-operative learning is generally defined as a teaching arrangement in which small, heterogeneous groups of students work together to achieve a common goal. Students encourage and support each other, assume responsibility for their own and each other's learning, employ group related social skills, and evaluate the group's progress. The basic elements are positive interdependence, equal opportunities, and individual accountability. In Cooperative learning, students assume new roles in the classroom. Their major roles are a collaborator and active participator. It is useful to think about how these new roles influence the processes and activities students conduct before,

during and after learning. For Example, before learning, students set goals and plan learning tasks; during learning, they work together to accomplish tasks and monitor their progress; and after learning, they assess their performance and plan for future learning. As a mediator, the teacher helps students fulfil their new roles.

Co-operative learning has been proven to be effective for all types of students (Colorado, 2017), including academically gifted, mainstream students and Science learners because it promotes learning and peer interaction, which helps the development of language and the learning of concepts and content. It fosters respect and friendships among a diverse group of students. The more diversity in a team, the higher the benefits for each student. Peers learn to depend on each other positively for a variety of learning tasks. It is based on these that the researcher decided to use Co-operative learning in balancing chemical equations in Chemistry, and find whether it will enhance students' academic achievement or otherwise. Also to find out if it will reduce students' anxiety levels or not. Studies such as Tobias, (2012) and Elliot, (2013) in Dahiru (2013) have shown that test anxiety affects the performance of science students. Anxiety is defined as an unpleasant sensation that is usually experienced as feelings of apprehension and general irritability accompanied by restlessness, fatigue, and various somatic symptoms such as headaches and stomachaches (Dahiru 2013). Anxiety may affect the academic performance of students according to (Elliot, 2000) this is called test anxiety. In other words, test anxiety is a reaction to examination stress, that is, the stress caused by testing conditions, such as examination.

In this study, therefore, the effect of Cooperative learning on student gender will be investigated. Gender refers to the amount of masculinity and femininity found in an individual (Bichi, 2015). Science educators such as Yoloye, (2012), Fakorede, (2013) and Okeke, (2017) have carried out several studies on gender difference and science learning, and they have revealed the under-representation of girls in science, mathematics and technical subjects in the secondary school level. The under-representation and underachievement are most



pronounced in the hard sciences i.e. physical science (Biology, Chemistry and Physics) than in natural science (Lawal, 2009). It is based on this that, this study attempted to investigate if academic achievements in balancing chemical equations are gender-related or not when the Cooperative learning method is applied.

Science educators, parents and other stakeholders in science education had been worried about the poor performance of students in SSCE and WASCE Chemistry for quite some time now. Despite the important position of Chemistry among other science subject and related disciplines, literature has revealed that students' performance in Chemistry in Senior Secondary School Certificate Examination (SSSCE) have been poor consistently (Njoku 2012 and WAEC Chief Examiners' report 2010-2012).

Therefore Chemistry concepts cannot be taught in abstract, students need to conduct themselves in a group and exchange ideas in form of a cooperative method on any given concept for them to understand better. The importance of student's centred methods (like the cooperative method) in science education is well known. It leads to functional meaningful knowledge. It is based on these that this research is set out to find whether the use of cooperative learning method in teaching balancing chemical equations will enhance students' academic achievement and reduce anxiety or not.

The objective of the Study

The following are the objectives of the study.

- i. To find out the effect of a Cooperative learning strategy on Chemistry students' academic achievement at the Senior Secondary School level.
- ii. To investigate the effect of cooperative learning on academic achievement about gender among Senior Secondary School Chemistry students.

Research Questions

The study sought to answer the following questions.

- i. Is there any difference in the academic achievement of Senior Secondary School (SSS) Chemistry students exposed to Co-operative learning and those exposed to lecture methods?
- ii. Is there any difference in the academic achievement of male and female Senior Secondary School (SSS) Chemistry students when exposed to Co-operative learning?

Research Hypotheses

Ho₁: There is no significant difference in the performance mean score of senior secondary students taught chemistry using cooperative learning strategy from those students taught chemistry using lecture method.

Ho₂: There is no significant difference in academic performance mean score of male and female students taught chemistry using a cooperative learning strategy.

METHODOLOGY

According to Kerlinger (2018), the research design is described as the plan, structure and strategy of investigation conceived to obtain the research questions and control variance. Therefore, the research design adopted for this study was quasi-experimental, focusing on the effects of cooperative learning strategy on the Academic Performance of Secondary School Chemistry Students in Sabon Gari Local Government Area of Kaduna State. A descriptive survey and quasi-experimental design were used for the study. Jibril, (2019) also said that large and small populations can be studied using this method, hence the use of this method was adopted by the researchers.

The population of this research work consists of all the chemistry students from the six (6) government senior secondary schools (4109) in Sabon Gari Local Government Area of Kaduna State. The sample size in research refers to the portion of the population which helps the researcher to obtain reliable results. A total of 80 students from two (2) selected senior secondary schools in Sabon Gari Local Government Area of Kaduna State were selected using the purposive random sampling technique.



The main instrument for data collection in this study is a researcher designed assessment test titled Chemistry Assessment Test (CAT). The first section (Section A) contains the general information such as sex, age, class and name of the school. Section B was multiple questions on Separation techniques.

The researchers visited the sampled schools to teach the students' separation techniques using 40 students as control and 40 as an experimental group that is, from the two purposively selected schools. Thus, after treatment of the control group using the lecture method and the experimental group with a cooperative learning strategy, both groups were given some task to handle and then the researchers tested the students using the Chemistry Achievement Test (CAT). The students were in their various classes, and with the help of their teachers, the researcher administered the test to them. The students answer the questions and the researchers waited to avoid the high mortality rate of the instrument.

Validation is the process of ensuring the degree of effectiveness of each of the items in the research instrument. It is the process of determining the extent to which each of the items measures what it was designed to measure (Asika, 2020).

The validity of an instrument is always determined by an expert opinion and vetting comprising of the researcher's supervisor and other experts attesting to its relevance and

appropriateness in the testing of the study. Therefore, the Chemistry Achievement Test (CAT) was validated by the project supervisor, and two other science education experts.

Reliability is necessary to ascertain whether the instruments are capable of reproducing consistent or similar results after several repeated administrations. Reliability tests are also carried out to determine whether the measuring instruments are consistent and reproducible.

The Chemistry Achievement Test (CAT) was administered to twenty (20) Senior Secondary School chemistry students in Zaria L.G.A and the split-half reliability statistic was used to calculate the reliability coefficient. Thus, this will make the Chemistry Achievement Test (CAT) suitable for the study.

Data analysis is the process of systematically applying statistical and/or logical techniques to describe and illustrate, condense, recap and evaluate data. Therefore, in this research work, the researcher will use the Statistical Package for Social Science (SPSS, version 22) as a statistical tool for data analysis.

RESULT AND DISCUSSION

Demographic Characteristics of Respondents

The data obtained from the field shows that forty (40) students which correspond to 50% of the respondent were males while four (40) which correspond to 50% of the students were females.

Test of Hypothesis

HO₁: *There is no significant difference in the academic performance mean score of senior secondary students taught chemistry using cooperative learning strategy from those students taught chemistry using the lecture method.*

Table 1: T-Test of Academic Performance Mean Score of Senior Secondary Students Taught Chemistry using Cooperative Learning Strategy from those Students Taught Chemistry using Lecture Method

Variable	N	X	S.D	S.E	Df	t-value	P	Remarks
Control	80	14.9	9.126	1.442	39	20.654	0.000	Sign.
Experimental	80	32.0	9.37	1.482	39	43.200		

Significant @ $P \leq 0.05$

HO₂: *There is no significant difference in academic performance mean score of male students taught chemistry using cooperative learning strategy from female students.*

**Table 2:** t-test Statistics of Academic Performance Mean Score of Male and Female Senior Secondary Students Taught Chemistry using Cooperative Learning Strategy and Students Taught Chemistry using Lecture Method.

Variable	N	X	S.D	S.E	Df	t-value	P	Remarks
Female	40	32.6	5.916	1.322	38	24.647	0.06	Sign.
Male	40	31.4	6.010	1.688	38	11.683		

Significant @ $P \leq 0.05$

DISCUSSION OF RESULTS

Table 1 shows the t-test result of the experimental group (those exposed to cooperative learning strategy) and the control group (those taught using lecture methods). It shows that there is significant difference in the performance of both sets of students since the alpha level of significance is conversant with the stipulated value of $P \leq 0.05$ and therefore the null hypothesis which says that; there is no significant difference in the performance mean score of senior secondary students taught chemistry using cooperative learning strategy from those students taught chemistry using lecture method is thereby rejected, and the alternative hypothesis which says there is significant difference in the performance mean score of senior secondary students taught chemistry using cooperative learning strategy from those students taught chemistry using lecture method is retained, and this is supported by Johnson *et al.*, (2019) who opined that Cooperative learning activities enhance elaborative thinking and more frequent giving explanations, which has the potential to increase depth of understanding, the quality of reasoning, and the accuracy of long term retention (Johnson *et al.*, 2019) and also Brad (2020) investigated the effectiveness of cooperative learning on students' academic performance in computer under cooperative and teacher-centered learning environments. He found that students in the cooperative learning group exhibited a higher level of academic performance.

Table 2 showed the result of the t-test comparing the performance of male and female students both exposed to cooperative learning strategy and lecture methods separately showing that there is no significant difference in the

performance of male and female students, since the alpha level of significance + is higher than the stipulated value of $P \leq 0.05$ and therefore the null hypothesis which says that; there is no significant difference in the performance mean score of Male and Female senior secondary students taught chemistry using cooperative learning strategy from those students taught chemistry using lecture method is thereby retained. This is in line with the study of Martin and Roland (2017) and is also confirmed by the finding of Lawrence (2016). They compared the effects of the cooperative learning method of the jigsaw and the traditional direct instruction method on the cognitive achievement in physics. Analysis of the result revealed no significant differences between the two groups of male and female students' cognitive achievement in chemistry.

CONCLUSION

Significant differences in students' chemistry achievement were found between experimental and control groups. After the treatment, experimental group students showed significant improvement in achievement in comparison to control group students. It was found that students' performance in chemistry was affected by exposure to cooperative learning. Students seem to prefer learning chemistry by sharing knowledge. They feel contented when they can function effectively in group work. It is hoped that the findings of this study may assist policymakers and teachers to identify appropriate measures that could promote cooperative learning in chemistry classrooms. The results of the study might also advance our understanding of the practical contribution of cooperative learning.



RECOMMENDATIONS

1. The cooperative learning method is strongly recommended to be used in teaching chemistry.
2. Additional research should be conducted on a large sample to increase the generalizability of the findings to the subject of education.
3. Future research should also focus on comparisons between different models of cooperative learning.
4. Cooperative learning intervention should be given for a long period to observe its effectiveness.

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