



Efficacy of Cooperative Learning Strategy on Academic Performance in Chemical Equations among Secondary School Chemistry Students in Abuja, Nigeria

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Abstract

The study examined the efficacy of cooperative learning strategy on academic performance in chemical equations among Secondary School Chemistry Students in Abuja, Nigeria. A quasi-experimental design involving pre-test and post-test was employed using a population of 689 SSI chemistry students in Kuje Area Council with a sample size of 85 students. A research question and null hypothesis was formulated and tested at $P < 0.05$ levels of significance. Cooperative Learning Strategy was used to teach experimental group chemical equations while lecture method was used to teach control group the same concept. Chemical Equations Performance Test (CEPT) was used for data collection with a reliability coefficient of 0.74 and was analyzed using t-test. The findings showed higher performance of students taught chemical equations using cooperative learning strategy than those taught using lecture method. Hence, teachers of chemistry should use cooperative learning strategy to improve academic performance of chemistry students among others.

Keywords: Chemical Equations, Chemistry, Cooperative-Learning, Performance

Introduction

Despite the importance of chemistry as one of the physical sciences, to the socio-economic and technological development of any nation, the performance of Nigerian students in the subject in both internal and external examinations has remained consistently poor (Jack & Kyado 2017). The performance of students in science reflects how well they understand science concepts and is a reflection of how good the instruction is (Muhammad, 2014). A study carried out by Anthony (2009) revealed that Senior Secondary School students have difficulties in learning certain chemistry concepts such as electrochemistry, electrolysis, oxidation-reduction reaction, chemical equilibrium and chemical equations. A number of studies have been carried out on how to improve the academic performance of students in chemistry, but poor academic performance still exists (Muhammad, 2014; Udo & Udofia, 2014; Jack & Kyado, 2017). A study conducted by Ahmad (2010) indicated that the inability of teachers and students to adopt different ways of learning and lack of exposure to current materials and resources for the learning processes are some of the challenges being faced by chemistry teachers and students.

The study adapts Number Heads Together (NHT) model of cooperative learning instructional strategy which is based on Vygotsky's social

development theory (Vygotsky, 1978). According to him, humans use tools that develop from a culture, such as speech and writing to mediate their social environments. He believed that the internalization of these tools led to higher thinking skills. Vygotsky's theory promotes learning contexts in which students play an active role in learning. Zone of Proximal Development is easier to be achieved during activities, such as in a cooperative learning group (Vygotsky, 1997). The shift towards students becoming more active learners is due to the belief that learners are naturally curious (Vygotsky, 1997). In the context of this study, this theory emphasises the need for students to be allowed to be actively involved in the learning process rather than being solely passive learners.

The constant use of the traditional lecture method as noted by Omwirhiren (2015) has led to inactive learning and a decrease in retention ability because it ignores the creativity of students. Therefore, there is need to provide an activity-based collaborative teaching strategy in teaching concepts which are perceived to be difficult at secondary school level. Cooperative learning was reported as an effective strategy for teaching chemistry at various level and places (Igboegwu and Egbutu 2011). Hence, in an attempt to possibly promote the performance and retention and equally solve the problem of poor performance of students in chemistry

at Secondary School level, the researcher examined the effect of cooperative learning strategy on academic achievement in chemical equations among senior secondary school students in Kuje Area Council, Abuja Nigeria.

Objective of the study

The objective of the study was to:

- i. determine the effect of cooperative learning strategy on chemistry students' academic achievement in chemical equations.

Research Question

The research question formulated was:

- i. What are the mean academic achievement of SS I chemistry students exposed to cooperative learning instructional strategy and those exposed to lecture method?

Hypothesis

The following null hypothesis was formulated to guide this study and was tested at $P < 0.05$ levels of significance.

H_0 : There is no significant difference in the mean achievement scores of students taught chemical equations using cooperative learning strategy and those taught using conventional lecture method.

Methods

The study employs the use of quasi-experimental control groups design, involving pretest and posttest. A pretest (O_1P) was administered to the two groups, (EG) and (CG) before the treatment (X_1) to determine the group equivalence in the variable of interest. The experimental group was taught the concepts of chemical equations using Numbered Heads Together Model while the control group was taught the same concepts using lecture method. At the end of the treatment (X_1) and lecture (X_0), a posttest (O_2PT) was administered to both groups to determine the effectiveness of the treatment on the subject competence on chemical equations. The treatment was done within eight weeks. The researcher used the same instrument all through, but the questions were reshuffled before the administration of the posttest. The research design is illustrated in Figure 1.

EG \rightarrow $O_1P \rightarrow X_1 \rightarrow O_2PT$

CG \rightarrow $O_1P \rightarrow X_0 \rightarrow O_2PT$

Figure 1: Flowchart of Research Design

Population for the study

The population for this study comprised all the nine Government Senior Secondary school year I chemistry students (SSI) in Kuje Area Council of Federal Capital Territory Abuja, Nigeria. Kuje Area Council is located at southwest of Abuja Township. The schools that formed the population include both boarding and day schools owned by the Federal Capital Territory Abuja government. The total number of the SS I students in the nine schools was six hundred and eighty-nine (689) with an average age range of 13 – 16years. One hundred and ninety-two (192) of population are male students while four hundred and ninety-seven (497) are female students.

Sample and sampling techniques

In selecting the sample for this study, four (4) out of the eight secondary schools were purposively selected. Kerlinger (1986) explained purposive sampling as non-probabilistic sampling, which is characterized by the use of judgment and a deliberate effort to obtain representative samples. The choice of the four Secondary Schools using purposive sampling is because they are co-educational schools as gender is one of the variables investigated in the study. Also, to avoid extraneous variable, boarding schools were purposively selected. The four selected schools were pretested and the scores were subjected to data analysis using Analysis of Variance (ANOVA) in order to choose two schools which are not significantly different in terms of the academic performance of the subject. Two out of the four schools were found not to be significantly different from each other in terms of their mean scores. Therefore simple random sampling technique, involving balloting was used to assign the two schools into the experimental and control groups. However, in selecting the student sample, intact classes were used for both the experimental and control groups.

Instrumentation

The instrument for data collection for this study is Chemical Equations performance Test (CEPT). The instrument is made up of fifty (50) multiple-choice items with four response options A – D adopted from Dahiru (2014) and Ababio (2011). The test items were used because they are part of the curriculum for SSI chemistry students and are appropriate for the cognitive level of the subjects tested. The content coverage of the instrument comprised concepts of



chemical equations. The items were distributed under six (6) levels of mental processes of the cognitive domain as outlined by Bloom (1956). The test blueprint adapted from Bloom’s taxonomy of educational objectives covered knowledge, comprehension, application, synthesis, analysis and evaluation respectively. The instrument was used for the pretest and post-test respectively.

CEPT was subjected to face validation by two Professors from Science Education Department and a lecturer with Ph.D in Chemistry Department, Ahmadu Bello University Zaria in terms of language clarity of the questions, proper wording of the items and also adequacy in terms of measuring what it was supposed to measure. Test-retest method was used to determine the reliability coefficient using Pearson Product-Moment Correlation (PPMC), which was found to be 0.74 which indicated that the instrument is reliable.

Administration of treatment

The first week of treatment was used for administration of pre-test to both the experimental and the control groups in order to determine the students’ entry behaviour in relation to their prior knowledge of chemical equations. Thereafter, the two groups which are the experimental and control groups were taught the same concepts of chemical equations for the period of eight weeks. The experimental group was exposed to cooperative learning strategy using Number Heads Together Model adapted from Maheady, Michelle-Pendl, Harper and Mallette (2006). The researcher trained the chemistry teacher of the school that was used as the experimental group, the teacher serve as the researchers’ assistant throughout the treatment period to ensure proper coordination. The researcher groups the students into small groups of 5 students with the last group having 4 students. Each student in a group has a personal number from 1-5 which the researcher gives him/her on a slip. The researcher begins the lesson by asking the students questions based on their previous knowledge and stating the aim of each lesson. After that, the students are given the task for the lesson of the day. All the groups were given the same task to

perform in their various groups inside the class. Each group studied together to find answers to the questions asked by the researcher. After the completion of the tasks, questions are asked based on the objectives of the lesson, a number between 1-5 is called, students bearing the number called in their various groups stood up and discussed their answers to the class, other numbers are called to discuss their response for better clarification. Finally, the researcher gives the students homework on the lesson of the day. The normal chemistry class period of the schools was used for the treatment each week and the treatment lasted for eight weeks.

In the control group, the researcher introduces the topic of each lesson and explains it. The lesson is then presented step-by-step using the lecture method. It was evaluated at the end of the lesson by asking the students questions based on the topic taught. The researcher also writes a note on the whiteboard and ask the students to copy it in their notebooks and finally conclude the lesson by summarizing the main points of the lesson. At the end of the eight weeks of the lessons, the CEPT was administered to both the experimental and the control groups to compare the academic performance of the students in the two groups.

Procedure for data collection

At the end of the eight weeks, CEPT was administered as a post-test to the students in the two groups. Students’ responses to the CEPT were collected and marked. The results were recorded based on research question and hypothesis.

Procedure for data analyses

The research question stated was analyzed using mean and standard deviation while the null hypothesis was tested for the post test scores analyzed using t-test at $p \leq 0.05$ levels of significance.

Results and Discussion

The data collected for the purpose of answering research question one was analyzed using mean and standard deviation and is shown in Table 1.

Table 1: Means and Standard Deviations of Students’ Academic Performance Scores in the Experimental and Control Groups

Groups	N	Pretest			Posttest			Mean Gain
		Mean	SD	MD	Mean	SD	MD	



Experimental	44	29.06	4.26		65.56	11.44	36.50
				1.05			22.49
Control	41	30.11	4.97		43.07	6.92	12.96

Mean gain= difference in academic performance score of posttest and pretest

The result in Table 1 shows that students in the control group had pretest mean score of 30.11 while those in the experimental group had 29.06 with a mean difference of 1.05. Similarly, students in the experimental group had higher posttest mean

academic performance score of 65.56 than those in the control group with posttest mean academic performance score of 43.07 with a mean difference of 22.49.

The hypothesis was analyzed using t-test at $p \leq 0.05$ alpha level. The result is presented in Table 2.

Table 2: t-test of Mean Performance of Experimental and Control Groups

Groups	N	Mean	Df	t	p-value	Remark
Experimental	44	65.56				
			149	11.87	0.01	Significant
Control	41	43.07				

Significant at $p \leq 0.05$

Table 2 reveals a significant difference between the posttest mean academic performance scores of students exposed to cooperative learning instructional strategy and those exposed to lecture method in learning chemical equations. This is because p-value of 0.01 obtained is less than the alpha level set at $p \leq 0.05$. The significant difference is in favour of students exposed to cooperative learning instructional strategy. Therefore, the null hypothesis which states that there is no significant difference in the posttest mean scores of the subjects exposed to cooperative learning instructional strategy and those exposed to lecture method of teaching is hereby rejected.

Discussion

Table 2 reveals a significant difference between the posttest mean academic performance scores of students taught chemical equations using cooperative learning strategy and conventional lecture method. The significant difference is in favour of students exposed to cooperative learning strategy. This might be due to the opportunity the students had to discuss with peers, brainstorm ideas, questions, argue, defend and explore the cognitive connections between previous knowledge, personal experiences and the information learned. The findings of this study is similar to that of Oloyede, Adeboowale and Ojo (2012), who reported that students exposed to cooperative learning strategy had significantly better academic performance over those students exposed to lecture method. Similarly, Ajaja and Eravwoke (2010), Olatoye, Aderogba and Aanu (2011) separately reported that the use of cooperative

learning strategy is more effective than lecture method of teaching in terms of improving academic performances of students. Also Abdullahi, (2014) conducted a study on the effects of cooperative learning strategy on self-efficacy and achievement in chemistry among concrete and formal reasoners and reported that students in the cooperative classroom performed significantly better than those students in lecture classroom.

Conclusion

From the findings, the following conclusion was drawn:

- i. Students taught the concept of chemical equations using cooperative learning instructional strategy had higher academic performance score than those taught using conventional lecture method.

Recommendations

On the basis of these findings, the following recommendations are made:

- i. Teachers of chemistry and other science related fields should employ the use of cooperative instructional strategy to improve academic performance of their students.
- ii. Ministry of Education should organise training for science teachers particularly chemistry through seminars and workshops at secondary schools on how to employ cooperative learning instructional strategy in the classroom.



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