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Effects of Two Modes of Innovative Instructional Strategies on Chemistry Students' Achievement in Senior Secondary Schools In Minna Metropolis, Niger State

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Abstract

This study investigated the effect of two modes of innovative instructional strategies on chemistry students' achievement in senior secondary school in Minna metropolis. Seventy two students were randomly selected from three senior secondary schools in Minna metropolis, they were randomly assigned to two experimental groups and one control group using. Chemistry achievement test (CAT) was used as instrument for data collection. Statistical analysis tools are the mean, standard deviation, t-test, and ANOVA, The result showed that there was significant difference in the mean score of experimental groups and control group. It was also showed that there was no significant difference in the mean score of male and female students of the experimental group. It was however recommended that innovative instructional strategies (JigsawII and STAD cooperative learning) should be adopted by chemistry teachers for the teaching of chemistry.

Introduction

Chemistry is the branch of science that studies matter, energy and their interaction. Aianah, (2008) defined chemistry as the science of matter that deals with the composition structure and properties of substance and with their transformation that they undergo. In relation to study of other fields, chemistry is basic and crucial in understanding them such as medicine, molecular biology, genetics pharmacology, atmospheric sciences, engineering, nuclear studies, materials science and many more fields, which made it a concerns in science education, for effective learning of chemistry.

Despite the prime position chemistry occupy in Nigerian educational system and efforts made by teachers and researchers to enhance achievement, students' still do poorly in chemistry. This agrees with Kola (2012) who finds that students' achievement and enrolment in theory and practical chemistry in Kwara State from 2005 to 2009 had been very low. Ezeano (2002) reported that the poor achievement in chemistry in external examinations in caused by lack of laboratory materials which resulted to inadequate practical before the examination. Kissau (2006) and Bosede (2010) assert that gender of the student influence student academic achievement in some subject areas.

The poor performance of students in chemistry, have being accounted for by various researchers. Notable among the problems that affect student achievement in chemistry is poor teaching strategy employed by teachers to teach chemistry, laboratory inadequacy, teachers' attitude, examination malpractice, time constraint for conduction of practice's, non-coverage of syllabus, class size, non-professionalism and environment, lack of understanding chemistry concept, poor academic background of students in Integrated science in Junior Secondary class, lack of interest on the part of students, students not interested in hard work,(Lawrence 2011; Adesoji and Olatunbosun 2008; Adesoji and Oginni 2012; Unanma, Abugu, Dike, and Umeobika 2013; Nbina 2012; Adesoji 2010). Other factors includes students' aptitude like mathematical and mental aptitude, the factors are reflected on transfer on learning. Adesoji and Oginni (2012).

Researchers have also observed that appropriate instructional strategy is a prerequisite for effective teaching and learning of chemistry, thus it is a professional obligation of the teacher to employ effective and conducive approaches of stimulating, motivating and managing the learner in a chemistry classroom setting (Ajelabi, 1998; Poepping and Mella, 2001; Adepoye, 1999). From the foregoing it can be concluded that there is the need to come up with innovations of instructional strategies that would not only promote student active participation but an approach that would promote student-student interaction. (Wellington, 1994).

Cooperative learning CL is one form of innovative instructional strategy that involve organizing classroom activities into academic and social learning experiences. Bukunola and Oludipe (2012), refers cooperative learning as the umbrella term for variety of educational approaches involving joint intellectual effort by students, or students and teacher together. Jumoke and Idowu (2012) reviewed the most prominent among many cooperative learning strategies, such as Learning together, Teams Games-Tournaments (TGT), Group Investigation, Constructive controversy, Numbered Heads Together, Jigsaw II Procedure, Students Teams Achievement Divisions (STAD), Complex Instruction, Team Accelerated Instruction (TAI),

In jigsaw II the Instruction proceeds according to the following stages of lesson planning: reading the assigned material, expert group discussion, team reporting, and finally team recognition. Each student in Jigsaw, after study in an "expert group, teach his/her peers a part of the subject matter. After instruction in Jigsaw II, teachers test students individually and produce team scores based on each student's test performance. (Oludipe and Awokoy 2010)

Student Teams Achievement Divisions (STAD) is one form of cooperative learning approaches that students work in 4-member heterogeneous teams to help each other master academic content. Teachers follow a schedule of teaching, team work, and individual assessment. The teams receive certificates and other recognition based on the average scores of all team members on weekly quizzes, (Tran 2013).

Several studied on CL have shown that it enhances students learning and social relations relative to traditional whole class method of teaching (Adeyemi, 2002; Akinbode, 2006; Bankole; Oludipe, 2012; Yusuf, Gambari and Olumouri, 2012). However there is the need find out which of these two modes of CL STAD and jigsaw enhances students performance better. This study will examine the effect of two modes of jigsaw and STAD forms of CL strategy on chemistry students' achievement among senior secondary school in Minna. The influence of gender will also be considered as moderator variable.

Research Questions

1. Will there be differences in achievement of students taught chemistry with jigsaw cooperative learning, STAD cooperative and conventional lecture method of teaching.
2. Does gender influence the performance of students taught using Jigsaw II, STAD and Conventional lecture method?

Research Hypotheses

The following null hypothesis will be tested at 0.05 level of

- HO1.** There is no significant difference in the performance of secondary school students taught chemistry using Jigsaw II STAD and Conventional lecture method.
- HO2.** There is no significant difference in the performance of secondary school students taught chemistry using Jigsaw II method.

Scope of the Study

The study covers senior secondary schools within Minna metropolis. The study also covered the

following chemistry concepts: Ionic bonds, Covalent bonds, Coordinate Covalent bond. Innovative instructional strategy used in this study is Jigsaw II and STAD forms of Cooperative Learning which belongs to the Constructivists learning theories.

Methodology

A pre-test post test experimental, control groups design was adopted for was the study. The population of the study was made up all senior secondary schools in Minna metropolis, in Niger State. The sample size consist 72 students (36 males and 36 female), who were randomly selected from three Secondary schools .The subjects were randomly assigned to two of the experimental group and one control group. The research instrument was made up of Chemistry Achievement Test (CAT adopted from West Africa Examination Council CAT).It consist of 36 multiple choice questions with five options. CAT was validated using content validity , and the reliability coefficient was determine at 0.77 using test retest method. The teaching was done for four weeks with the control group being taught with conventional lecture method, and the two experimental groups were exposed to Jigsaw II and STAD forms of cooperative learning. The data were collated and analyzed using Analysis of Covariance (ANOVA) and Scheffe post hoc test using Statistical Package for Social Sciences (SPSS) at 0.05 confidence level.

Results

The data collected from the study were analyzed and presented in tabular form below.

Table 1: Summary of ANOVA Results of Pretest Score of the Groups.

Groups	S S	df	mean	F-cal	P
Between Groups	50.861	2	25.431	0.395	0.675 ^{NS}
Within Groups	4443.458	70	64.398		
Total	4494.319	72			

Not significant at $p > 0.05$

Table 1 presents ANOVA result of Experimental Group 1, Experimental group 2 and control group. The result shows that there is no significant difference in the performance of students in the pretest score ($p > 0.05$). This implies that the three (3) groups were equivalent or comparable before the treatment.

HO1. There is no significant difference in the performance of secondary school students taught chemistry using Jigsaw II, STAD and Conventional lecture method.

Table 2

Summary of ANOVA Comparison of the Post-test Scores of Experimental groups I, Experimental groups II and Control group.

Groups	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	10219.444	2	5109.722	34.037	.000
Within Groups	10358.333	70	150.121		
Total	20577.778	72			

S= Significant $P < 0.05$

Table 2 presents the ANOVA results of Experimental group 1 (JIGSAW II), Experimental group 2 (STAD) & Control Groups. The result shows that it is significant because $P < 0.05$. This implies that hypothesis one is rejected. To determine the sources of differences, the data was subjected to scheffe's post hoc Test as shown in Table 3 below.

Table 3
Scheffe's Post-Hoc Analysis of the Groups Mean Scores

Variable(i)	Variable(j)	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
(Jigsaw)	STAD	13.750*	3.537	.001	4.90	22.60
	CTM	29.167*	3.537	.000	20.32	38.02
(STAD)	Jigsaw	-13.750*	3.537	.001	-22.60	-4.90
	CTM	15.417*	3.537	.000	6.57	24.27
(CTM)	Jigsaw	-29.167*	3.537	.000	-38.02	-20.32
	STAD	-15.417*	3.537	.000	-24.27	-6.57

*. The mean difference is significant at the 0.05 level.

Scheffe's analysis on Table 3 indicated that the observed significant difference was between Jigsaw II and STAD, Jigsaw and Control as well as STAD and Control. However the highest mean differences of 29.17 and highest upper boundary of 38.02 at 95% confidence level is found between Jigsaw group and CTM Group in favor of the Jigsaw II group. Also the higher mean differences of 15.42 and highest upper boundary of 24.27 at 95% confidence level is found between STAD group and CTM Group in favor of the STAD group. There is significant difference in the mean score of Experimental 1, Experimental 2 & Control. This significant difference was between jigsaw and CTM also STAD and CTM

HO2. There is no significant difference in the performance of secondary school students taught chemistry using Jigsaw II method.

Table 4
t-test Analysis of Gender Achievement on Jigsaw II group

Variable	N	Df	Mean	SD	t-value	P	Remarks
Male	12		67.50	14.222	4.644	0.65 ^{ns}	Not
		22					Significant
Female	12		70.00	12.060			

ns = not significant $p > 0.05$

The result on table 4 presents the t-test result of male and female of experimental 1 (students who were taught using Jigsaw II). The t-value is however not significant at 0.05 level of significance ($P > 0.05$). It means that there is no significant difference in male and female students' achievement taught with jigsaw II cooperative learning instructional strategy.

Findings

The findings of the study are presented as follows:

1. The two modes of cooperative learning strategies employed in this study (Jigsaw II and STAD) produced more positive effect on students' learning outcomes than the conventional lecture Method.
2. The result shows that the Jigsaw II had more positive effect on students' Chemistry achievement than STAD.
3. The findings showed that gender had no influence on the performance of students in Chemistry when taught with Jigsaw II cooperative learning strategy.

Discussion of Results

The pre test result shows no significant difference in the performance of students in the three (3) groups. This implies that they were equivalent before the treatment. From the result, the null hypothesis one was rejected, indicating that there is a significance difference among these three groups. The findings agree with the earlier findings of Durmus (2008), Hanz and Berger (2007), Abdullah (2010), İlker and Murat (2013), Mbacho and Bernard (2013), Bukunola and Oludipe (2012), Yusuf, Gambari and Olumorin, (2012).

The gender performance shows that there is no significance difference between male and female achievement and thus the null hypothesis was retained. This infer that Jigsaw cooperative learning, treated fairly and averagely equal learning of chemistry among male and female students without discrepancy. This finding was supported by the findings of Yusuf, Gambari and Olumorin, (2012) which shows that Jigsaw II treated gender averagely equal in achievement level. The result of the study also showed that the use of Cooperative Learning does not only gave rise efficient learning, but also developed students in effective social interactions, self confidence and collaboratively engage in societal activities. It also enhance positive dependence among students with accountability and high level of mastery contents with much retention. The low performance of students in CLM group implies that attention needs to be shifted to students involvement in learning activities and also depending on the social context of the classroom, the students may benefit from being able to interact freely and socially with other students as they learn

Conclusion

The study concludes that Jigsaw II and STAD innovative instructional strategies enhance Chemistry students' performance than the conventional lecture method. It also showed that Jigsaw II enhances better performance than STAD. There was also no difference in terms of gender performance of chemistry students.

Recommendations:

From the findings of the study it was recommended that the use of Jigsaw and STAD cooperative learning strategy should be encouraged for teaching Chemistry subject in Secondary Schools in Niger state. These teaching strategies carter for heterogeneous and diversified state of classroom complexity, having every individual profiting from the learning activity in the classroom.

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