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Research Article

Effects of Learning Together and Jigsaw II Learning Strategies on Upper Basic II Science Students' Achievement and Retention in West Senatorial District, Nasarawa State, Nigeria

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Abstract: This study investigated the Effects of Learning Together and Jigsaw II Learning Strategies on Upper Basic II Science Students' Achievement and Retention in Nasarawa State, Nigeria. Two research questions and two hypotheses guided the study. This study adopted a quasi-experimental research design. It is a pre-test, post-test and post-post-test, non-equivalent, non-randomized control design. Simple random and purposive sampling technique were employed to draw 88 Upper Basic II science students in Nasarawa State West Senatorial District as sample for the study. Basic Science Students' Achievement Test (BASSAT) consisting of 40-multiple choice items was uses as instrument for data collection, the reliability of the instrument was determined using Kuder-Richardson formula 21 ($K\text{-}R_{21}$), The coefficient of internal consistency for BASSAT was 0.82. The data collected from the administration of instrument was analyzed using the following statistical techniques. Descriptive statistics, which involve the computation of the pretest, post-test and the post-post-tests mean scores, standard deviation were used to answer research questions and Analysis of Covariance (ANCOVA) was used to test hypotheses at 0.05 level of significance. The findings of this study reveals significant difference between the achievement of students in Learning Together and Jigsaw II learning strategies, in favour of the Learning Together group. Also reveal significant difference between the retention of students in Learning Together and Jigsaw II learning strategies, in favour of the Jigsaw II group. Based on the findings of this study it was recommended that; Basic Science teachers should be encouraged to develop and adopt Learning Together and Jigsaw II Learning Strategies so as to improve and promote social interaction active learning, discovery learning, motivation, learning by doing and learning by experience among students which will lead to enhanced overall achievement and retention..

Keywords: Achievement; Jigsaw II, Learning Together and Retention.

INTRODUCTION

Basic Science is a subject taught from the lower basic school to the upper basic school levels (Nwafor, 2012). It is an introduction to the study of the sciences at the Senior Secondary school level; it is a study of elementary biology, anatomy, earth/solar system, ecology, genetics, chemistry and physics among other science related subjects as a single science subject at the basic school level. It offers the basic training in scientific skills required for human survival, sustainable development and societal transformation. It involves bringing together traditionally separate subjects so that learners will grasp a more authentic understanding (Nwafor & Oka, 2016).

The general objective of Basic Science education is to enable students observe and explore the environment using their senses and their hands. The objective specifically aims at enabling the learners to develop interest in science and technology, acquire basic knowledge and skill in science and technology, apply their scientific and technological knowledge and skill to meet their societal needs, take advantage of the numerous career opportunities offered by science and technology and become prepared for further studies in science and technology (NERDC, 2009). Despite the importance of Basic Science in the country's quest for scientific and technological advancement, there has been seeming ineffectiveness in the teaching and learning of the subject which in turn is strongly affecting the attainment of the country's laudable objectives and goals of developing a scientific and technologically literate citizenry. Researchers such as Bukunola and Idowu (2012); Osokoya (2013); Alabi (2014); Oni (2014); Kabutu, Oloyede and Bandele (2015); Samuel (2017); Eriba and Samuel (2018); Agu and Samuel (2018) observed that poor learning strategies employed in the teaching of Basic Science by teachers contribute to students under achievement.

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Students find it difficult to understand the basic concepts taught and because they are not well grounded in Science at the basic level, they show little or no interest in offering core science and technology subjects at the Senior Secondary and tertiary level (Idowu, 2011).

At the upper basic II school level, Work, Energy and Power are topics taught under the sub-theme of You and Energy (Federal Ministry of Education (FME), 2012). A glossary look at the past Basic Education Certificate Examination (BECE) question papers shows that that students cannot escape answering questions in Work, Energy and Power. Researchers such as Bukunola and Idowu (2012); Bilesanmi and Oludipe (2012); Danjuma (2015); Ishaq (2015); Eriba and Samuel (2018); Agu and Samuel (2018) reveal that these core topics among others are generally identified as difficult concepts in Basic Science, this may also be a part of the reasons for underachievement of students in Basic Science. This indicates that these concepts need serious attention of scholars and educators to find other strategies of teaching them differently from the conventional way Basic Science teachers handle the teaching and learning of Basic Science.

Although attempts have been made to improve students' achievement and the quality of Basic Science learning in schools, students' achievement in Nasarawa State is low as seen in the Basic Education Certificate Examination shown in Table 1.

Table 1. Statistics of Basic Science Students' Achievement (Results) by Grade for June/July Basic Education Certificate Examination (BECE) (2013-2017) in Nasarawa State

Year	Number of candidates registered	% Grade (A1-C6)	% Grades (D7-E8)	% Grades (F9)
2013	13751	24.09	26.51	49.40
2014	12821	22.46	25.84	51.70
2015	99850	28.30	34.98	36.72
2016	10257	26.94	37.45	35.61
2017	98780	31.52	32.04	36.44

Source: Department of Statistics, Ministry of Education, Nasarawa State (2017)

Table 1 shows that the percentage credit passes and above in Basic Science continues to fall below 50% for the period of five years as reviewed, although grades D7 and E8 are considered to be passes but they are not good enough for candidates to go for science-oriented subjects in the Senior Secondary School level. The underachievement, according to the chief examiner for the years 2013-2017 was as a result of poor understanding of general principles and concepts such as heat, energy, work, power, kinetic theory of matter and thermal energy. Other attributes that could lead to students' underachievement includes; attitudinal problems of students, cognitive and socio-economic problems of teachers, administrative problems of policy makers, inappropriate instructional strategies employed by the teachers and also teacher factor which may be due to poor mastery of subject matter which result in skipping of topics. This underachievement in Basic Science forms the basis of this study.

To achieve the objectives of Basic Science and the goals of upper basic education as stipulated in the National Policy on Education (FRN, 2014, Pp.12-16) which include among others, to inspire students with a desire for self-improvement and achievement of excellence, to raise a generation of people who can think for themselves, respect the views and feelings of others, respect the dignity of labour and live as good citizens, there is need for effective learning strategies (Bukunola & Idowu, 2012). The traditional pedagogical practice, which is confined to transmitting information and involves telling, reading and memorizing and the teacher adopting the "fountain of knowledge" approach, has failed to cope with the problems of scientific knowledge needed for development (Osokoya, 2013). Appropriate pedagogical approaches therefore need to be sought in order to pass the message of science across to the learners (Samuel, 2017). Alabi (2014) observed that students learn best by active participation in the teaching and learning process, such pedagogic concept could be engaged through social interaction, togetherness and action-oriented communication.

Learning Together strategy of cooperative learning were originally developed by David Johnson and Rogers Johnson at the University of Minnesota (Johnson & Johnson, 1991). Students work in four or five heterogeneous groups on a group assignment sheet. During discussion, the students share the opinions about the task. The learning together strategy of cooperative learning provides a conceptual framework for teachers to plan and tailor cooperative learning strategy according to their circumstances, students' needs and school contexts. Bilesanmi and Oludipe (2012); Unamba, Ugochukwu and Nwaebo (2015) opine that learning together cooperative learning strategy can improve students' achievement and retention in Basic Science at the basic school level.

Jigsaw cooperative learning strategy was originally developed by Aronson and colleagues in 1978. Jigsaw II requires students to work in heterogeneous group of five to six members. Each student in a group is given information that no one else in the group has access to, thus making each student knowledgeable in his or her section of the subject matter. After receiving their assignments, each team member reads a section. Next, members of different teams who have studied the same sections meet in "expert groups" to discuss their sections. Then the students return to their original teams and take turn to teach their team mates what they have learnt. All students in a group are expected to learn all the subject matter assigned to members of their group. After instruction in Jigsaw II, teachers test students individually and produce team scores based on each student's test performance. Researchers such as Azahin (2010); Bilesanmi and Oludipe (2012); Yusuf, Gambari and Olumorin (2012); Egbulefu, Amaele and Sunday (2015); Gambari and Yusuf (2017) reveal that Jigsaw II cooperative learning is capable of enhancing students' achievement in Science.

Achievement is the action of accomplishing an academic task successfully by students. Its purpose is to find out the stand of a student at a given moment (Akani, 2017). It has to do with testing the knowledge acquired by the student which help the teacher and the student to evaluate and predict the degree of learning attained. It is useful in testing the retention of information and skill. It is also a determinant of the efficacy and efficiency of a given instruction (Kabutu, Oloyede & Bandele, 2015).

Retention is the ability to hold, keep or recall past experience and reproduce a learnt concept when the need arises (Bukunola & Idowu, 2012). It is an important variable in learning, because only a learnt experience is recalled. Learning cannot be said to have taken place if there is no proper retention. The ability of students to recall past learnt Basic Science concepts as an objective of the Basic Science teaching and learning process may likely enhance achievement in the subject. For so long, researchers have been keen on knowing what could be done by teachers to enhance maximum retention of knowledge or skills long after they have been acquired whether in the classroom or outside the classroom (Azuka, 2012).

Statement of the Problem

The consistent under-achievement in Basic Science has been attributed to the inappropriate learning strategies adopted by teachers. Rote learning, parroting of unfamiliar ideas and regurgitation of facts have been the features of these strategies. The outcome of this is that such instructional strategies have not adequately enhanced and improved the Basic Science students' achievement and retention. Poor approach to teaching invariably translates to students' inability to put into practice what they have learnt into reality. In most cases, what is taught in the classroom cannot be transferred to real life situations by the students. The under-achievement in Basic Science among Upper Basic School students raises doubt on the efficacy of the learning strategies utilized by Basic Science teachers which if not mitigated will jeopardize the students' placement of 60:40 in favour of the sciences at the tertiary level of learning as stipulated in the National Policy on Education. This will affect the competitiveness required to develop national capability and self-sufficiency in Science, Technology and Innovation. The problem of this study therefore is, what are the effects of Learning Together and Jigsaw II learning strategies on Upper Basic II Science students' achievement and retention in Nasarawa State, Nigeria?

Objectives of the Study

The purpose of this study is to investigate the effects of Learning Together and Jigsaw II learning strategies on Upper Basic II Science students' achievement and retention. Specifically, this study sets out to determine the following objectives:

1. The effects of Learning Together and Jigsaw II learning strategies on students' achievement in Basic Science.
2. The effects of Learning Together and Jigsaw II learning strategies on students' retention in Basic Science.

Research Questions

The following research questions guided the study.

1. What are the mean achievement scores of Basic Science students exposed to Learning Together and Jigsaw II learning strategies?
2. What are the mean retention scores of Basic Science students exposed to Learning Together and Jigsaw II learning strategies?

Statement of the Hypotheses

The following null hypotheses were tested at 0.05 level of significance.

Ho_1: There is no significant difference in the mean achievement scores of Basic Science students exposed to Learning Together and Jigsaw II learning strategies.

Ho_2: There is no significant difference in the mean retention scores of Basic Science students exposed to Learning Together and Jigsaw II learning strategies.

METHODOLOGY

This study adopted a quasi-experimental research design. It is a pre-test, post-test and post-post-test, non-equivalent, non-randomized control design. Quasi-experimental research design is used when it is not possible to randomize individuals to treatment and control groups, intact classes were used so as not to disrupt the school programmes. Simple random and purposive sampling technique were employed to draw

the sample for the study. The sample for the study is made up 88 Upper Basic II science students in Nasarawa State West Senatorial District. This sample size is considered adequate as it possessed important characteristics which were representative of the target population. The instrument used for data collection was a researcher made Basic Science Students' Achievement Test (BASSAT). BASSAT consisted of 40-multiple choice items adopted from Basic Education Certificate Examination (BECE, 2013-2017) from the concepts of Work, Energy and Power taught during the study. The instrument was used for the pre-test, post-test and post-post-test to obtain data on students' achievement and retention of Basic Science concepts taught. The reliability of the instrument was determined using Kuder-Richardson formula 21 ($K\text{-}R_{21}$), The coefficient of internal consistency for BASSAT was 0.82. The data collected from the administration of instrument was analyzed using the following statistical techniques. Descriptive statistics, which involve the computation of the pretest, post-test and the post-post-tests mean scores, standard deviation were used to answer research questions and Analysis of Covariance (ANCOVA) was used to test hypotheses at 0.05 level of significance.

DATA ANALYSIS AND RESULTS

Data obtained from the study were analyzed and the results are as follows:

Research Question One

What are the mean achievement scores of Basic Science students exposed to Learning Together and Jigsaw II learning strategies?

Table2. Means, Standard Deviations and Mean Gain Achievement Scores of Basic Science Students Exposed to Learning Together and Jigsaw II Learning Strategies

		Pre-test		Post-test		
Group	N	**Mean**	**SD**	**Mean**	**SD**	Mean Gain
Learning Together	40	17.20	5.51	27.03	3.91	9.83
Jigsaw II	48	17.35	3.63	23.92	2.69	6.57

Table 2 shows mean gain achievement score of Basic Science students exposed to Learning Together learning strategy is 9.83 and for those exposed to Jigsaw II learning strategy is 6.57.

Research Question Two

What are the mean retention scores of Basic Science students exposed to Learning Together and Jigsaw II learning strategies?

Table3. Means and Standard Deviations of Basic Science Students' Retention Scores Exposed to Learning Together and Jigsaw II Learning Strategies

Group		**Posttest**	**Retention**	**Retention Score**
	Mean	27.03	22.92	4.11
LT	N	40	40	
	Std. Deviation	3.912	3.392	
	Mean	27.46	22.73	4.73
JIGII	N	48	48	
	Std. Deviation	2.689	2.735	

Table 3 shows mean retention score of Basic Science students exposed to Learning Together learning strategy is 4.11 and for those exposed to Jigsaw II learning strategy is 4.73.

Hypothesis One

There is no significant difference in the mean achievement scores of Basic Science students exposed to Learning Together and Jigsaw II learning strategies.

The test for this hypothesis provided the data on Table 3.

Table 4. Results of Analysis of Covariance on Students' Achievement in Basic Science using BASSAT

Source	**Type III Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**
Corrected Model	1373.063[a]	2	343.266	48.773	.000
Intercept	3988.800	1	3988.800	566.750	.000
Pretest	345.255	1	345.255	49.056	.000
Group	741.046	1	247.015	35.097	.000
Error	1273.883	83	7.038		

Total	118198.000	88
Corrected Total	2646.946	87

a. R Squared = .519 (Adjusted R Squared = .508)

Table 4 reveals a significant difference in the mean achievement scores of Basic Science students exposed to Learning Together and Jigsaw II learning strategies. F = ratio of 35.097 was obtained with associated exact probability value of 0.000. Since the associated probability (0.000) is less than 0.05 set as level of significance, the null hypothesis was rejected. The result implies that the Learning Together and Jigsaw II learning strategies produced a significant effect on the post-test achievement scores of students when covariate effect (pretest) was controlled. Hence, there was a significant difference among the two groups.

Hypothesis Two

There is no significant difference in the mean retention scores of Basic Science students exposed to Learning Together and Jigsaw II learning strategies.

The test for this hypothesis provided the data on Table 4.

Table 5. Results of Analysis of Covariance on Students' Retention in Basic Science using BASSAT

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	2077.409[a]	2	519.352	84.180	.000
Intercept	311.946	1	311.946	50.562	.000
Posttest	226.004	1	226.004	36.632	.000
Group	725.480	1	241.827	39.197	.000
Error	1116.682	83	6.170		
Total	79567.000	88			
Corrected Total	3194.091	87			

a. R Squared = .650 (Adjusted R Squared = .643)

Table 5 shows a significant difference among the methods of instruction on retention. F = ratio 39.197 was obtained with associated exact probability value of 0.000. Since the associated probability (0.000) was less than 0.05 set as level of significance, the null hypothesis was rejected. The result implies that the learning strategies produced significant effects on the retention scores of students when covariance effect (posttest) was controlled.

DISCUSSION OF FINDINGS

The findings of this study reveals significant difference between the achievement of students in Learning Together and Jigsaw II learning strategies, in favour of the Learning Together group. The findings also reveal significant difference between the retention of students in Learning Together and Jigsaw II learning strategies, in favour of the Jigsaw II group. These findings are in agreement with the earlier findings of Eriba and Samuel (2018[a]); Eriba and Samuel (2018[b]); Agu and Samuel (2018[a]); Agu and Samuel (2018[b]) Samuel (2018); Gambari and Yusuf (2017); Gambari, Yusuf and Thomas (2015); Timayi, Bolaji and Kajuru (2015); Nnorom (2015); Egbulefu, Amaele and Sunday (2015); Kabutu, Oloyede and Bandele (2015); Odagboyi, Otuka and Uzoechi (2015); Sabiru (2014), who found out that students taught Basic Science, Physics, Chemistry, Biology and Mathematics using cooperative learning strategies (Learning Together and Jigsaw II) achieved better than those taught using the conventional teaching methods.

The trend of improved achievement and retention by the groups could be as a result of the enabling learning environment provided where students worked in a team, were motivated and all team members benefited through sharing, helping one another, explaining and encouraging one another to learn. Another reason for better achievement experienced by the treatment groups could be because the students were captivated, more focused, attentive and interested in what they were doing. This no doubt offered slow learners opportunity to catch up with the fast learners. Basic Science students' achievement could greatly improve if they are allowed to take charge of their learning. Interaction among the students provides a better opportunity to develop cognition. As provided by Vygotsky (1978) social learning theory, knowledge is the result of social interaction and learning can occur in groups of similar skilled individuals if they are motivated to help each other. This is also in agreement with Bruner (1960) discovery learning theory which posited that when students are allowed to discover new ideas by themselves, they learn better.

CONCLUSION

The findings of this study revealed that there was high significant difference between the mean achievement and retention scores of the Learning Together and Jigsaw II learning strategies. These results imply that the learning approaches employed by Basic

Science teachers in teaching might have been partly responsible for the persistent under-achievement and retention of students in Basic Students since they were using the conventional methods, most of the times.

Recommendations

The following recommendations are made based on the findings of the study:

1. Basic Science teachers should be encouraged to develop and adopt Learning Together and Jigsaw II Learning Strategies so as to improve and promote social interaction active learning, discovery learning, motivation, learning by doing and learning by experience among students which will lead to enhanced overall achievement and retention.

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