Effect of Jigsaw II teaching Technique on Biology Students' Academic Performance in Senior Secondary Schools in Dutsin-Ma Metropolis, Katsina State.

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Abstract

The study was carried out to investigate the effect of jigsaw II cooperative teaching technique on Biology students' academic performance in senior secondary schools in Dutsin-ma metropolis Katsina State. The study adopted Quasi-Experimental pre-test, post-test control group design. The population of the study comprised of 802 SSII Biology students of public secondary schools from Dutsin-ma metropolis. A sample of 60 SSII biology students was drawn by simple random sampling techniques from two co-educational schools in Dutsin-ma Educational zone. Two objectives, two research questions and two null hypotheses where formulated to guide the study. The instrument used for data collection was biology performance test (BPT) which was validated by experts, with test-retest reliability index of 0.67, the data was analyzed using mean for all the research questions and analysis of co-variance (ANCOVA) was used to test the null hypotheses at 0.05 level of significance. The findings revealed significant difference ($p<0.05$) in the biology students' performance in the experimental and control groups The students taught biology by jigsaw II cooperative teaching technique achieved significantly higher than their counterparts that were taught using traditional lecture method. The findings also showed that female students performed slightly better than male students when taught with jigsaw II teaching technique. Teachers of biology are therefore recommended to adopt jigsaw II teaching technique in this 21st century classroom to encourage group learning among students.

KEY WORDS: Jigsaw, teaching technique, Biology, academic performance

Introduction

Biology is the branch of Science that involves the study of living and non living things. The national policy on education (2004) defined secondary education as the education children receive after primary educational level before the tertiary state. The dismal performance of secondary school students both in internal and external examinations in biology in recent years has attracted a great deal of attention from scholars, researchers and academics alike (Adeyemi ,2006). Several factors have been identified to be responsible for student's poor academic performance in examinations, biology inclusive. These include teacher's negative attitude to work, use of inappropriate teaching methods, failure to accomplish teaching tasks, student's lackadaisical attitude to study, infrastructural decay and lack of instructional materials in schools. The challenge for educators of science is to continually think of innovative ways to make science more responsible and relevant. Science teachers are challenged to be more innovative and creative for higher student's achievement and favorable attitude at the same time (Gernale & Araries, 2015). Some teachers of science still stagnated in the traditional way of teaching the subject making them less effective teachers, these teachers think that the conventional method is the only best pedagogy in science. The teachers in the traditional method tend to be the sole purveyor of knowledge and ask students to work individually, results in boredom because there are no ongoing tasks, challenging activities and creative works to be accomplished by the learner. In the field of education, especially science education cooperative learning is one of the cardinal innovative practices. Jigsaw teaching technique has been found to be very effective (Poonam & Gunjan,2009). It is a collaborative teaching technique that was first developed by the psychologist Elliot Aronson (1971) to strengthen the bond among pupils irrespective of their race, gender or locality. It is an instructional strategy that employs motivational technique to make learning more interesting and relevant. Jigsaw II is a cooperative learning model that involves small groups of 5-6 students teaching each other subject matter with success dependent upon student's cooperation (Gonleksiz, 2007).In Jigsaw II co-operative instructional strategy students are assigned to study and understand the basic concepts of the materials. Then each student is given a topic on which to become an expert. Students with the same topic/section meet in expert groups

to discuss their topics after which they return to their original teams to teach what they have learnt to their teammates, then students make group and individual quizzes that result in a team score based on the improvement score system (Slavin,2006).

Several researchers suggested that if implemented well, cooperative learning strategies increased student's motivation, reasoning, thinking skills, student's achievement and active learning. It was also found that this technique lessens the anxiety and disruptive behavior of students (Slegel, 2005; Poonam & Gunjan, 2009).

By working in a team or cooperative groups, the students get an opportunity to develop interpersonal skills that will be helpful in their future carrier. Unlike personal learning or competition in the classroom, jigsaw II teaching technique encourages students to sink or swim together (Poonam & Gunjan,2019) .Many researchers have suggested that jigsaw II teaching technique is successfully used in teaching various subjects and at any level of education (Poonam & Gunjan, 2019).Teachers of science need to re-examine how they teach science subjects and move from a traditional didactic method to a more productive method. It was also found that jigsaw II teaching technique proved beneficial for increasing student self-efficacy in vocational training courses. Walker, Olvet and Chandral (2015) reported that Jigsaw II teaching method is a new education tool for the medical curriculum. It allows for a peer discussion of a large amount of material in a short period of time. Aydin and Biyiki (2017) concluded that jigsaw II teaching technique has a positive effect on student's success and participation in learning and making the physics experiment. Jigsaw II teaching technique is therefore useful in biology and chemistry experiments. Karacop & Diken (2017) suggested that science teachers can develop the cognitive skills of students by employing the jigsaw II teaching technique and integrating it into laboratory practices .This method is beneficial for the elimination of misconceptions about particular subject (Aydin & Biyiki, 2017)).Cooperative learning has been used for several years for enhancing students' achievement (Slegel 2005; Poonam & Gunjan,2019).

According to Van Wigit, (2015) teachers expressed positive attitudes towards jigsaw II learning and enjoyed the group spirit. Sabbah (2016) suggested that jigsaw II strategy empowers the students to take charge of their learning, retention, peer tutoring, communication skills and retrieval of concepts. The strategy decreases stress, tension and absentmindedness and also help the students in overcoming hesitation and shyness. According to Adesoji, Omilani and Nyimebi, (2015); Bogan and Khan, (2016); Tran, (2016) the traditional didactic lecture method should be replaced by an interactive method like jigsaw II teaching technique to facilitate learning. Gracia, Abrego and Robert (2017) found that students preferred non-traditional and collaborative method of teaching. Jigsaw II teaching technique is an enjoyable and educational method to learn. The findings of this study will be beneficial to secondary school biology teachers by helping them to use teaching and learning strategies which arouse the interest and high participation of the learners. The outcome of the study will also help biology teachers, students, parents and education planners. The scope of the study was limited to secondary schools in Dutsinma metropolis, SS2 students were selected because they are more stable than SS1 and SS3 students are busy preparing for their SSCE examination.

Statement of the problem

Students perform poorly in biology because of ineffective teaching techniques employed by teachers (Ige & Aremu, 2005). The effectiveness of teaching and learning process can be facilitated through appropriate strategies adopted in the learning environment (Adesoji,*et: al,* 2015). The challenge for educators of science is to continually think of innovative ways to make science more responsible and relevant. There are many methods, techniques and strategies in impacting knowledge to students but

there is no denying fact that the methods of teaching adequately promote students understanding. Due to individual differences, teachers owe it as a duty to employ varieties of techniques in teaching and learning in order to offset the problem of boredom and more importantly enhance students understanding of what is taught. Science teachers are challenged to be more innovative and creative for higher student achievement and favorable attitudes at the same time (Gernale & Araries, 2015). Unfortunately, some of the teachers especially the science teachers do not want to change their mode of delivery, they stick to the traditional lecture methods which proved ineffective and are the source of many problems (Francis, 2013; Tran, 2016). In order to minimize the challenges learners face while learning science, student-centered active learning strategies are recommended as an alternative to the traditional learning methods that center teachers (Adesoji,*et: al*, 2015). This leads to the study Effect of Jigsaw II teahing technique on the academic performance of Biology students in senior secondary schools in Dutsinma metropolis. The study is meant to empower teachers to adopt and implement appropriate strategies in their teaching so that learning can be made easier and interesting.

Purpose of the study

The study sought to determine

1. Whether there is any significant difference between the mean academic performance of students taught biology using jigsaw II teaching technique and those taught by traditional lecture method in senior secondary schools in Dutsinma metropolis

2. Whether there is any significant difference between the mean academic performance of male and female students taught biology using jigsaw II teaching technique in senior secondary schools in Dutsinma metropolis.

Research Questions

1. What is the mean difference in the academic performance of students taught biology using jigsaw II teaching technique and those taught using the traditional lecture method in senior secondary schools in Dutsinma metropolis?

2. What is the mean difference in the academic performance of male and female students taught biology using jigsaw II teaching technique in senior secondary schools in Dutsinma metropolis?

Research Hypotheses

HO_1. There is no significant difference in the mean academic performance of students taught biology using jigsaw II teaching technique and those taught by traditional lecture method.

HO_2. There is no significant difference between the mean academic performance of male and female students taught biology using jigsaw II teaching technique

Research Methodology

Research Design

The study used Quasi experimental pre-test, post-test, control group design. SSII biology students from two (2) intact classes of two (2) public co-educational secondary schools in Dutsinma metropolis formed the sample size of the population. These two secondary schools were selected randomly. SSII biology students from one of the selected school formed the experimental group while SSII biology students

from the other school formed the control group. A pilot test was also carried out in another separate school. Before the treatment a pre-test was administered. Then both the experimental and control groups were exposed to treatment for six (6) weeks. After the six (6) weeks administration of the treatment, both the experimental and control groups were subjected to a post test. The instrument used for gathering data is Biology performance test (BPT).The validity of the instrument was tested by experts from Science Education Department, Federal University Dutsinma and Isa Kaita College of Education Dutsinma through test and retest method. The BPT contains thirty multiple choice questions. The data collected from pre and post tests were analyzed using Pearson Product Moment Correlation coefficient (PPMC). Means and standard deviations were used to answer the research questions. Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance.

The research design is represented in figure 1

$EG = O_1 \rightarrow X_1 \rightarrow O_2$

$CG = O_1 \rightarrow X_0 \rightarrow O_2$

Where:

EG: represents experimental group

CG: represents control group

O_1: represents pre-test

O_2: represents post-test

X_0: represents teaching using conventional method

X_1: represents the treatment using jigsaw II teaching technique

Population, Sample and Sampling Procedure

Population for the study consists of 802 SSII biology students in senior secondary schools in Dutsinma Metropolis, Katsina state.

Table 1: Population of SSII Biology students in Senior Secondary Schools in Dutsinma Metropolis.

S/N	NAMES OF SCHOOL	MALE	FEMALE	TOTAL
1.	GovtSci Sec SchDutsinma	293	---	293
2.	Govt Pilot Sec SchDutsinma	54	78	132
3.	Govt Day Sec SchDarawa	84	52	136
4.	Comm Day Sec SchDutsinma	73	59	132

5.	Govt Girls Arabic Sec SchDutsinma	_	57	57
6.	Govt Girls Sec SchDutsinma	_	52	52
TOTAL		**504**	**298**	802

Source: Dutsinma zonal education and quality assurance, 2021

Out of the six co-educational secondary schools in Dutsinma metropolis, two schools were purposively sampled. This enabled male and female students to participate in each school. SSII biology Students in one of the selected school represent the experimental group while SSII biology Students in the other school represent the control group. In each of the schools thirty students served as the sample size for the study.

Table 2: The sample size for the study

Selected Schools	Male	Female	Total
GDSS Dutsinma	15	15	30
GDPSS Dutsinma	15	15	30
Total	**30**	**30**	**60**

Instrumentation

The instrument used for data collection in this study was Biology Achievement Test (BPT). The instrument for data collection was the Pre-test and post-test questions. The test items were standardized questions developed using biology text book based on the content that was taught in the lesson. The instrument contained thirty (30) items multiple choice objective questions with four (4) options A-D each. Despite using standardized items from the national examination bodies (WAEC, NECO, & NABTEB). The selected items on concept of Aquatic habitats were still given to senior lecturers who are PhD holders from Science Education Departments, Federal University Dutsinma and Isa Kaita College of Education Dutsinma for critiques and suggestions, to ensure the validity of the (BPT), and also to verify the construct, face and content validity of the instrument. Test and re-test method was used in testing the test items for the reliability

Coefficient. The data obtained was subjected to statistical analysis using Pearson product moment correlation coefficient (PPMC). The reliability of the test items was found to be 0.67, this means that there is a positive correlation between the 1st and 2nd CA tests with high reliability index hence, the instrument is reliable for use.

The instrument was administered to twenty (20) students, then after two weeks the same test was re – administered to the same students, the first and second scores were compared using Pearson Product Moment Correlation (PPMC). The students used for estimating the reliability coefficient (Pilot testing)

was not part of the sample, the reliability coefficient was found to be 0.67.The experimental group was taught concept of aquatic habitat using jigsaw method of teaching while the control group was taught the same concept using conventional lecture method. The two groups were exposed to the same pre and post-tests. The pre-test was initially administered to students before the treatment. At the end of the six-weeks treatment post-test was administered to those groups. The result obtained from the pre and post-tests was used for data analysis.

The data obtained from the pre and post-tests was analyzed using mean and standard deviation. Mean and standard deviation was used to answer the research questions while analysis of covariance (ANCOVA) was used to test the null hypotheses at 0.05% level of Significance

Results

R.Q1: What is the mean difference in the academic performance of students taught biology using jigsaw II teaching technique and those taught biology using the traditional lecture method in senior secondary schools in Dutsinma metropolis?

Table 3 : Pre-test, post-test and Mean Gain Scores of Students' Academic Achievement in Experimental and Control Groups.

Group	N	Pre –test	Post –test	Mean Difference
Experimental	30	8.27	23.97	**3.94**
Control	30	10.77	20.03	

Table 3 shows that students taught biology using jigsaw II teaching strategy performed better than Students taught using the lecture method. The Post-test scores of students in Experimental group was (23.97) which is greater than the Post-test scores of students in control group (20.03) With Mean gain of 3.94.

R.Q2: What is the mean difference in the academic performance of male and female students taught biology using jigsaw II teaching technique in senior secondary schools in Dutsinma metropolis?

Table 4: Pre-test, Post-test and Mean gain of Male and Female Students' Academic Achievement in Experimental Group.

Students	N	Pre-test	Post-test	Mean gain
Males	15	11.47	20.87	2.26
Females	15	11.67	23.13	

Table 4 presents the result of male and female students taught biology using jigsaw teaching strategy. The result revealed that, female students performed better than male students, the Post-test scores of male students was (20.87) While the scores of female students was (23.13) With Mean gain of 2.26. This result shows that the academic achievements of female students is higher than that of the male students when taught biology using jigsaw teaching strategy.

Hypotheses Testing

Table 5: Analysis of covariance (ANCOVA) of the difference in the academic achievement of students taught Biology using jigsaw II teaching techniques and those in the control group and differences of male and female students taught biology using jigsaw teaching techniques in experimental group.

Source	Type III Sum of squares	df	Mean square	F-cal	P<0.05	Decision
Corrected model	77.69[a]	2 S	38.846	0.65	0.04	Sig
Intercept	3391.26	1	3391.26	37.68	0.00	Sig
Pre-test	159.83	1	159.83	10.85	0.02	Sig
Treatment	368.95	1	368.95	25.03	0.00	Sig
Gender	29.75	1	29.75	1.87	0.18	not Sig
Error	840.10	57	14.74			
Total	27692.00	60				

Table 5 shows that F-value for treatment is 25.03 with significance at 0.00 which is less than 0.05 level of significance. This result indicates that there is a significant difference in the achievement of students that are taught biology using jigsaw teaching techniques and those that are taught using lecture method. Therefore, null hypotheses one (H_{o1}) which states that: There is no significant difference between the academic achievement of students taught Biology using jigsaw teaching techniques and those that were taught using lecture method is therefore rejected.

Also Table 4 Shows that the F-value for gender in experimental group is 1.87 with significance at 0.183, which is greater than 0.05 level of significance. This result indicates that there is no significant difference between the academic achievements of male and female students when taught biology using jigsaw teaching techniques. Therefore, the null hypotheses two (H_{o2}) which states that: There is no significant difference between the academic achievement of male and female students taught Biology using jigsaw teaching strategy is hereby retained

Discussion of Findings

The objective of the study was to investigate whether jigsaw II teaching strategy will enhance achievement in biology and to find out if gender will affect the rate of achievement.

Table 3 and 4 revealed that the Post-test scores of the students taught biology using jigsaw teaching strategy is 23.97 while that of the students taught biology using lecture method is 20.03 with the Mean gain of 3.94. The Analysis of covariance (ANCOVA) revealed a computed F-value of 25.03 and the significance level of 0.00 It was concluded that since the critical value of 0.00 is less than the alpha value of 0.05, therefore, there is a significant difference between the academic achievement of the students taught biology using jigsaw II teaching strategy and those that were taught using lecture method. A significant difference implies rejection of the null hypothesis. Therefore the result of this study showed that students taught biology using jigsaw II teaching strategy outperformed their counterparts that were taught using the lecture method. This finding agrees with the work of Marhamah & Mulyad (2013) in which they found out that there was a significant difference between the mean achievement scores of students taught with jigsaw teaching strategy and those taught using group discussion strategies. The finding is also in line with Aronson and Patronoe (2013) who stated that Jigsaw classes showed greater academic achievement than lecture classes. This finding also agrees with that of Tahar and Acar, (2012) who found that using jigsaw method to teach chemistry yield better result than the conventional methods. This finding also with that of Gocer, (2010) who found that students taught using jigsaw teaching strategy performed better than those taught using the conventional lecture method.

Table 4 and 5 revealed that the Post-test scores of male students taught using jigsaw teaching strategy is 20.87 while that of female students is 23.13 with the Mean gain of 2.26. The analysis of covariance (ANCOVA) revealed a computed f-value of 1.87 and the significance level of 0.18. It was concluded that since the critical-value of 0.18 is greater than the alpha value of 0.05, the findings therefore indicate that there is no significant difference in the academic achievement of male and female students exposed to jigsaw teaching strategy therefore the null hypothesis is retained. This study agrees with the study carried out by Uduosoro, (2011) and Abubakar and Oguguo(2011) who found no significant difference in the performance of boys and girls when taught with jigsaw teaching strategy. Meanwhile this study contradicts that of Blume (2013), Bilesanmi, (2010) and Zembar and Hume (2011) who all found that female students performed better than male students when taught using jigsaw teaching strategy. The study also contradicts that of Abubakar and Oguguo, (2011,) who found in their researches that male students performed better than female students when exposed to jigsaw teaching strategy

Summary of Findings

From the findings, it could be summarized that:

1. Jigsaw teaching technique was found to be effective in teaching and learning of biological concepts in secondary Schools.

2. It is evident from the findings of this study that the use of jigsaw teaching techniques could provide a very good way for students to learn Biology.

3. Jigsaw teaching strategy was proved to be a very effective way to enhance performance in biology and it is not gender dependant.

Jigsaw teaching strategy should therefore be used as an additional teaching techniques to other traditional methods of teaching sciences.

Conclusion

Jigsaw II teaching technique improves senior secondary school students academic performance in biology because it has been indicated from the findings of the study that there is a significant difference in the mean academic scores of students in favor of the experimental group. Jigsaw II teaching technique promotes the academic performance of both male and female students in learning biology and this is evident from the second finding of the study that states that there is no significant difference in the mean academic performance of students when taught with jigsaw II teaching technique.

Recommendations

Based on the findings, the followings recommendations were made:

1. As the use of jigsaw teaching strategy has been found effective in promoting academic performance in Senior Secondary School Biology and since this teaching method is relatively new in Nigeria, it should be included in the Biology Curriculum of teachers training tertiary institution, so as to popularize its use among the teachers and hence bring about more effective learning of Biology in our secondary schools.

2. In view of the established efficacy of the jigsaw teaching strategy and the fact that most of the serving Biology teachers may not be familiar with its use, seminars and workshops should be organized by government and relevant professional bodies e.g. Science Teachers Association of Nigeria (STAN) to educate and sensitize the teachers on the use of the jigsaw II teaching technique in the teaching and learning of Biology.

3. As students of different ability levels have been shown to benefit differently from biology lesson with respect to academic performance using jigsaw teaching strategy, Biology students should be placed in classes according to their ability levels, to prevent the slow learner being "dragged" by the fast Learners.

4. Government agencies and professional associations whose responsibility is to design and revise the curriculum for secondary schools should incorporate and emphasize the use of jigsaw teaching techniques in this 21st century to encourage group learning in Biology among senior secondary students.

5. Government agencies and professional bodies such as NERDC and STAN should sponsor further researches on the efficacy of the jigsaw teaching strategy in promoting performance in other units of senior secondary schools Biology.

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