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Effectiveness of Cooperative Learning Strategy on Nigerian Junior Secondary Students' Attitude towards Learning Basic Science

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Abstract: This study investigated the effectiveness of cooperative learning strategy on Nigerian Junior Secondary students' attitudes toward learning basic science. Quasi experimental pretest – posttest control group design was used by the researcher to carry out the study. The treatments were at two levels cooperative learning strategy (jigsaw II) and conventional lecture method (control). The moderating variable was gender (male and female).Total number of one hundred and fifty students (150) obtained from the intact classes of the two selected Junior Secondary Schools in South-west Nigeria participated in the study. Basic Science Attitude Scale (BSAS) was the main instrument used to collect data from students. Descriptive statistics and Analysis of Covariance (ANCOVA) were used to analyze the data collected. The results of this study indicated that there were significant main effects of treatment on students' attitude towards basic science. Furthermore, there were no significant interaction effects of treatment and gender on students' attitude toward learning basic science. The researcher proffered useful recommendations.
Keywords: cooperative learning, effect, attitude, basic science, gender, junior secondary school.

INTRODUCTION

Science education plays a vital role in the lives of individuals and the development of a nation scientifically and technologically [1]. It is widely and generally acknowledged that the gateway to the survival of a nation scientifically and technologically is scientific literacy which can only be achieved through science education. Towards revolutionizing Nigerian educational system, the 1969 Conference on Curriculum Development gave birth to the National Policy on Education which brought about significant changes to the Nigerian educational system [1].For instance, in Nigeria, the National Policy on Education (2004) provided educational expenditure in science and technology. The Nigerian government, in a bid to enhance science and technological education, came up with 6-3-3-4 policy on education which stipulates that a child spends six years at the primary school level, three years at the Junior Secondary School level,three years at the Senior Secondary School level, and four years in Higher Institutions [2]. This system of education was reviewed in 2004 and came up with 9-3-4 system which stipulates that a child spends 9 years compulsorily right from primary school level to Junior Secondary School level, three years at the Senior Secondary School level, and four years in Tertiary Institutions.

All the above-mentioned systems of education in Nigeria are designed with special provisions for science and technology learning in schools. More so, Nigerian government also came up with a policy that 60 percent of the students seeking admission into the nation's Universities, Polytechnics, and Colleges of Education should be admitted for science oriented courses, while 40 percent of the students should be considered for Arts and social science courses [3].Basic science, formerly known as Integrated Science, is the first form of science a child comes across at the secondary school level; hence basic science prepares students at the Junior Secondary School level for the study of core science subjects at the Senior Secondary School level [2]. This implies that for a student to be able to study single science subjects at the Senior Secondary School level successfully, such student had to be well grounded in basic science at the Junior Secondary School level. In view of this, basic science is given great emphasis in the Junior Secondary School curriculum. The principal reasons why Nigerian Government started Basic Science teaching in Nigerian secondary schools are as follow:

1. It provides students at the Junior Secondary School level a sound basis for continuing science education either in single science subjects or further integrated science;
2. It enhances the scientific literacy of the citizenry;
3. It allows students to understand their environment in its totality rather than in fragments;
4. It allows the students to have general view of the world of science;

5. The processes of science serve as unifying factor for the various science subjects. It is necessary for the learner to know these processes through integrated approach of learning science [4].

In an attempt to improve the standard of science teaching and learning, a lot of research studies had been carried out. Studies in Basic science education have reported that many students at the Junior Secondary School level have developed negative attitude towards the subject [5]. Many of the students at this level, because of their dismal performance in the subject, are not benefiting much from the basic science curriculum [6-11]. This, according to [10], has prevented many of them from offering core science subjects or performing better in the core science subjects at the Senior Secondary School level. The Nigerian government's efforts towards making sure that Nigerian children show interest in science and science-oriented courses (e.g. 60:40 ratio admission policies in favour of the science-oriented courses, etc) cannot be said to have yielded much fruit. This is because many of the students at the Junior Secondary School level (J.S.S) are not showing interest in studying core science subjects (physics, chemistry, and biology) at the Senior Secondary School level. This has affected many of them in choosing science-oriented courses at the Nation's tertiary institutions level. The problem stemmed from the conventional-lecture method being used by the basic science teachers at the J.S.S. level which makes the subject looks abstract to the students; hence many of them see science generally as difficult. Several studies had been carried out in order to popularize appropriate teaching strategy for teaching and learning basic science. Empirical studies in Nigeria support the use of cooperative learning strategies in integrated science teaching and learning process, but many of these studies were limited to the effectiveness of the cooperative learning on students' academic achievement. They did not examine the effectiveness of cooperative learning strategies on students' attitudes toward basic science. In view of this, this study examined the effect of cooperative learning strategies on Nigerian Junior Secondary students' attitude toward basic science. The possible influence of gender on students' attitudes toward basic science was also examined.

Hypotheses

Ho_1:Thereis no significant main effect of treatment on students' attitudestowards basic science.

Ho_2:There is no significant main effect of gender on students' attitudes towards basic science.

Ho_3: There is no significant interaction effect of treatment and gender on students' attitudes towards basic science.

EXPERIMENTAL/MATERIALS AND METHODS

Instrument for Data Collection

Basic science attitude rating scale was used to gather useful pieces of information from the students. The instrument was the adapted 20-item chemistry attitude rating scale by [12]which students responded to by expressing their level of agreement or otherwise on a 4-point Likert-type scale ranging from Strongly Agreed = 4, Agree = 3, Disagree = 2, Strongly Disagree = 1.The points were in reverse order for the items with negative wordings. The instrument was validated by giving it to experts in the field of Psychology for their professional input. To ascertain reliability of the instrument, it was trial tested by administering it to forty students from an intact class of a co-educational Junior Secondary School III (JSS III) different from the selected schools for the main study. The reliability of the instrument was determined by using Cronbach coefficient alpha which was found to be 0.85. Participating teachers in the experimental group were exposed to comprehensive training programs so that they did not deviate from the instructional principles and procedures governing the experiment. Before exposing the selected students for the study to the different methods, the students were given the questionnaire on attitude for their responses. Students in the experimental group were taught using the cooperative learning strategy (Jigsaw II), while students in the control group were taught using the conventional-lecture method. The post administration of the same questionnaire on basic science attitude rating scale was done within the week after the completion of the treatments.

Methods of Data Analysis

The data collected from the administration of the instrument were analyzed using the descriptive statistics, which involved the computation of the pretest, posttest mean scores, and standard deviation, for each of the dependent variables; Analysis of Covariance (ANCOVA) was computed for each dependent variable for the two instructional groups.

Cooperative Learning Strategy

Cooperative learning strategy involves a situation in which students work together cooperatively and interdependently in small groups towards a group goal [13]. Cooperative learning is the umbrella term for a variety of educational approaches involving joint intellectual effort by students, or students and teachers together [14]. It requires a small number of students to work together on a common task, supporting and encouraging one another to improve their learning through interdependence and cooperation with one another [15]. The cooperative learning groups are usually groups of two to five that allows everyone to participate in a clearly designed task ([14]; and[16]). Students within small groups' cooperative learning are encouraged to share ideas and materials and divide the work when appropriate to complete the task. Small group competitive learning provides students with opportunity to explore and discuss topics with peers in a Bonds-on, interactive environment [15]. [17]affirmed

that students benefit academically and socially from cooperative small group learning.

Jigsaw II Strategy

Jigsaw II cooperative learning strategy was originally developed by Aronson and Colleagues in 1978 [16]. Jigsaw I requires students to work in group of five to six members. Each student in a group is given information to which no one else in the group has access, thus making each student "expert" on 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 teaching 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 the small group instruction, students are tested on the subject matter and receive individual grades or other rewards. The afore-mentioned Aronson's version of Jigsaw does not meet Slavin's effectiveness requirements because it incorporates neither a group goal nor individual accountability for contributing to the achievement of a group goal. Slavin, in 1986, developed a variation of Jigsaw called Jigsaw II. Like Aronson's Jigsaw, each student in Jigsaw II, after preparing in an "expert group, teaches 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.

Attitude and Science Achievement

There are expectations of motivations on the part of both the learner and the teacher during the teaching and learning of science. The special concern of science educators is the achievements of students in science and their attitudes towards science. The word attitude (from Latin aptus) is defined within the framework of social psychology as a subjective or mental preparation for action. Attitude means the individual's prevailing tendency to respond favourably or unfavourably to an object – person or group of people, institutions or events ([18]; and [19]). Social psychologists, according to [20], distinguish and study three components of the responses: (a) Cognitive component, which is the knowledge about an attitude object (whether accurate or not), which, in scientific term, means learning of the scientific concepts, developing problem-solving skills and the understanding of the scientific method. (b) Affective component which refers to the feelings towards the object, this implies enhancement of motivation towards science and positive perceptions of student's ability to understand the environment. (c)Behavioural component, which is the action taken towards the object.

There is more to learning science than giving knowledge and developing skills. The central importance of doing science has to do with the area of the affective, i.e. the personal acceptance and enjoyment of and commitment to scientific activity. Motivation is an internal state that arouses, directs, and sustains behaviour. Attitudes influence motivation, which in turn influences learning and ultimately behavior [21]. Motivation to learn is a student tendency to find academic meaningful and worthwhile and to try to derive the intended academic benefits from them. The affective domain underlies the cognitive dimension of learning science; it is associated with student's awareness of characteristics of his environment, display of new behaviour as a result of experience, and student's initial values and ability to integrate a new value to the original values system. Students' attitudes toward science subjects are a significant predictor of students' achievement in these subjects [22]. [23] reported that students with positive attitudes towards school subjects perform better in such subjects than students with negative attitudes toward the subjects.

If science teachers display positive attitudes toward the teaching of science subjects, they will use suitable teaching strategies which will bring about students' positive attitudes towards science teaching and learning. [24]submitted that teaching style appears to be the major determinant of students' attitudes toward science and science teaching. Both cognitive and affective domains are strongly interrelated thus suggesting the reason why the science teachers should not only develop positive attitudes toward teaching and learning science but should also always employ teaching strategies that incorporate motivational methods. Factors such as teaching strategies, classroom environment, the use of small group work, and positive interaction among peers go a long way to determine students' attitudes ([18] and [25]). They further asserted that teachers should make efforts to relate scientific concepts to pupils' lives, experiences and their environment.

Effect of Cooperative Learning on Students' Attitudes

Students' attitudes play a powerful role in achievement pattern, course taking decision, and career choices; hence attitudes have also been the focus of more than one study in cooperative learning [26]. Some researchers, while investigating the effects of cooperative learning on students' achievement, examined the effect of the cooperative learning on students' attitudes. [27]studied the effect of cooperative learning on students' attitude toward science. Students were grouped into cooperative learning and traditional method groups. He found that students in the cooperative learning group had positive attitudes toward science. Another study conducted by [28] found that students in the experimental group (cooperative learning) held positive attitudes toward mathematics. Similarly,[29] investigated the effectiveness of cooperative learning on students' achievement in

computer under cooperative and teacher-centered learning environments. He found that students in cooperative learning group exhibited greater level of positive attitudes to learning.[30]compared the effects of classroom interpersonal goal structures. High school technology education students were assigned to groups with either cooperative-competitive or cooperative-cooperative goal structure. The results showed that students in the cooperative-cooperative environment showed more positive attitudes toward the subject than their colleagues in cooperative-competitive group. In the same vein, [31] studied the effects of cooperative learning in a classroom and examined whether cooperative learning could make up for the disadvantages of the traditional teacher oriented classroom. Results indicated that there was a positive correlation between cooperative learning and attitude.

[32]investigated the effectiveness of Jigsaw cooperative learning method and traditional competitive method on students' academic achievement and attitudes toward science. He used a two-way analysis of variance on the 3 x 2 factorial designs to test for any significant difference in students' achievement and attitudes toward science due to the two instructional methods. The results of the analysis indicated, among other findings, a statistically significant difference in students' attitudes toward science favouring the Jigsaw method.[33]investigated gender differences and the effects of cooperative learning in mathematics classroom setting. The researcher used quasi-experimental design to compare a control section using individualized learning method with three treatment sections using cooperative learning methods based on the Learning Together model of Johnson and Johnson (1991). The results revealed that male and female students each improved their attitudes toward mathematics.

[35]conducted a project with the methods of STAD, Jigsaw and Learning Together in an EFL junior high classroom. The findings revealed, among others, that students' learning attitudes changed positively. [36]examined the effect of cooperative learning using STAD as a model. Students were assigned to cooperative learning and traditional (competitive) groups. Results indicated positive attitudes towards mathematics favouring the STAD group. [37] investigated the differential effects (i.e. achievement in learning English, and attitude concerning English Language) on students between the traditional teaching method and the Jigsaw cooperative learning method. Data analysis indicated that students in Jigsaw cooperative learning group had more positive attitudes about the learning mechanism they experienced than students who were taught using the traditional method.

[38]studied the effect of Teams-Games-Tournament (TGT) and no game playing condition on students' achievement in mathematics. Multivariate Analysis of Variance was used to analyze the data collected. The analysis of results showed that cooperative game playing was most effective for promoting positive mathematics attitudes regardless of individual differences. However, [39] study deviated from the results of all the afore-mentioned research studies. He investigated gender differences in self-efficacy, attitudes toward mathematics, and achievement of 48 gifted 7^{th} and 8^{th} grade students. The students were randomly grouped into cooperative and whole - group instruction (competitive setting). The researcher used pretest-posttest group design. The results showed that statistically significant differences in attitudes toward mathematics were found favouring students in the competitive setting. [40], using TGT, showed that there was no significant difference in students' attitudes toward mathematics between TGT instructional group and traditional instructional group.

RESULTS

Descriptive Statistics

---- asindicated in table 1 [appendix A] ----

In table 1, it is revealed that students in the jigsaw II group had the higher mean score of 65.80 than the students in the conventional-lecture method group with the mean score of 53.13. Gender wise, male and female students in the jigsaw group had the higher mean scores of 65.70 and 65.90 respectively than their male and female colleagues in the conventional-lecture method whose mean scores are 54.06 and 52.15 respectively.

Test of Hypotheses Involving Main and Interaction Effects of Treatment and Gender on Students' Attitudes towards Basic Science

---- asindicated in table 2 [appendix B] ----

Hypothesis 1(Ho_1)

Ho_1: There is no significant main effect of treatment on students' attitudes toward basic science.

In table 2, it is revealed that the treatment had significant effect on students' post-attitude scores in basic science ($F_{1,\ 149}$ = .000, statistically significant). This is an indication that there was significant main effect of treatment on students' post-attitude scores in basic science. That is, the post-attitude scores of the students exposed to the different treatment conditions were significantly different. Hence, the null hypothesis (Ho_1) was rejected.

Hypothesis 2 (Ho_2):

Ho_2: There is no significant main effect of gender on students' attitudes towards basic science.

In table 2, it is also revealed that gender had no significant main effect on students' post-attitude scores in basic science ($F_{1,\ 149}$ = .096, statistically not significant). This is an indication that there was no significant gender difference in the students' post-attitude scores in basic science. That is, the post-attitude

scores of the male and female students were not significantly different. Hence, the null hypothesis (Ho_2) was not rejected.

Hypothesis 3 (Ho_3):

Ho_3: There is no significant interaction effect of treatment and gender on students' attitudes toward basic science

In table 2, it is further revealed that there was no significant interaction effect of treatment and gender on students' post-attitude scores in basic science ($F_{1, 149}$ = .175, statistically not significant). Hence, the null hypothesis (Ho_3) was not rejected.

DISCUSSION

This study was conducted to establish the effectiveness of cooperative learning strategy on students' attitudes toward basic science. Results from tables 1&2indicated that the two teaching strategies used had effects on the students' attitudes toward basic science. There was significant difference in students' attitudes toward basic science in the two treatment groups with jigsaw II strategy having the higher positive effect, while conventional-lecture approach had the lowest positive effect. This result implies that cooperative learning strategy enhanced students' attitudes toward basic science more than the conventional-lecture approach.

This result is in line with the findings of [29-37] who reported in their different studies that cooperative learning strategies enhanced students' attitudes towardslearning in their different subject areas more than the conventional-lecture approach. However, the finding of this study contradicts the findings of some other researchers who have reported no significant difference in the students' attitudes toward learning of basic science between cooperative teaching group and groups - conventional lecture, competitive, & individualistic approaches.

Results along gender line, as shown in tables 1 & 2, revealed that there was no significant difference in the male and female students' attitudes toward learning basic science. This implies that students' attitudes toward basic science is gender invariant, which means that gender, as a single factor, did not contribute significantly to the differences in students' attitudes toward basic science.

With respect to the interaction effects of the variables on students' attitudes toward learning basic science, it is shown in table2 that there was no significant interaction effect of treatment and gender on students' attitudes toward learning basic science, which means that treatment did not interact with gender in determining students' attitudes toward learning basic science. This implies that gender, as a single factor, did not contribute significantly to the differences in students' attitudes toward learning basic science, suggesting that the effectiveness of cooperative learning strategy on students' attitudes toward learning basic science was not associated with gender characteristics.

CONCLUSION

Based upon the finding of this study, the following conclusions were drawn:

1. There was significant main effect of treatment (jigsaw II and conventional-lecture approach) on all the dependent measures. The Post-attitude mean scores of students in the treatment groups (jigsaw II and conventional-lecture) were different from one another. This asserted the positive effectiveness of cooperative learning strategy on students' attitudes toward learning basic science over the conventional-lecture.
2. There was no significant main effect of gender on the students' attitudes toward learning basic science.
3. There was no significant interaction effect of treatment (jigsaw II and conventional-lecture approach) and gender on the students' attitudes toward learning basic science.

Implications and Recommendations

This study has very important contributions and high implications for the educational practices in Nigeria. This study revealed that students in the cooperative learning strategy (Jigsaw II) group had higher post-attitude mean scores than the students in the conventional-lecture group. Jigsaw II cooperative learning strategies was found to be more effective in enhancing students' attitudes toward learning basic science more than the conventional-lecture approach. When friendliness is established, students are motivated to learn and are more confident to ask questions from one another for better understanding of the tasks being learnt. Hence this motivates them to attend basic science classes regularly

Based on the findings of this study, the following recommendations were made:

1. Basic science teachers should adopt cooperative learning strategies in order to enhance students' attitudes toward learning basic science.
2. At the pre-service level, the use and implementation of cooperative learning strategies in the classrooms should be emphasized in the methodology courses being offered by the Student-teachers; and
3. At the in-service level, seminars and workshops should be organized by ministry officials, zonal educational authority, and local educational authority in order to educate practicing teachers on how to implement cooperative learning strategy in schools at all levels.

APPENDIX A

Table 1: Descriptive Statistics of Post-attitude Scores According to Treatment and Gender

Treatment	Gender	Mean	Std. Deviation	N
Lecture	Male	54.06	3.346	36
	Female	52.15	2.630	34
	Total	53.13	3.148	70
Jigsaw	Male	65.70	.911	40
	Female	65.90	.900	40
	Total	65.80	.906	80
Total	Male	60.18	6.318	76
	Female	59.58	7.154	74
	Total	59.89	6.727	150

APPENDIX B

Table 2: Summary of Analysis of Covariance of Students' Post-Attitude Scores According to Treatment and Gender

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	6199.386(a)	4	1549.847	413.340	.000	.919
Intercept	863.997	1	863.997	230.426	.000	.614
Pre-attitude score	140.467	1	140.467	37.462	.000	.205
Treatment	4796.444	1	4796.444	1279.200	.000	.898
Gender	10.541	1	10.541	2.811	.096	.019
treatment * gender	6.978	1	6.978	1.861	.175	.013
Error	543.687	145	3.750			
Total	544705.000	150				
Corrected Total	6743.073	149				

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