

DO ALL COOPERATIVE LEARNING STRATEGIES HAVE THE POTENTIALS TO ELIMINATE GENDER DIFFERENCE IN STUDENTS' ACHIEVEMENT IN BIOLOGY? A FIELD REPORT ON STAD AND JIGSAW STRATEGIES

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Abstract

The study examined gender as a factor in the achievement of biology students taught using Students' Team Achievement Division (STAD) and Jigsaw cooperative learning strategies in Wamba Local Government Area of Nasarawa state Nigeria. The research adopted the non randomized, pretest – posttest control group quasi experimental design. A sample of 188 students comprising of 95 boys and 93 girls from 6 randomly selected schools was used. A 30 item instrument called Biology Students Achievement Test (BSAT) developed by the researchers with a reliability coefficient of 0.84 using Kuder-Richardson formula 21 was used for data collection. The schools were grouped into 3 and assigned randomly into 1 control and 2 experimental groups. The control was taught using Lecture method while cooperative learning was used in experimental groups. Intact classes were used in all the schools, students were pre tested, treated for 6 weeks and post tested. Data collected were analyzed using Mean, Standard deviation and ANCOVA at 0.05 level of significance. The result shows that the difference in the mean achievements of boys and girls in the 2 methods was insignificant. Teachers therefore should use the methods in teaching and seminar, workshops and conferences should be organized to train the teachers.

Keywords: Gender stereotype, culture, Achievement in biology, cooperative Learning, Students Team Achievement Division, Jigsaw

Introduction

For a nation to develop scientifically and technologically, it must effectively implement its science education curriculum to ensure that the citizens acquire the scientific skills, attitudes, knowledge and principles in order to apply same in solving problems leading to such development. While science is defined as the systematic investigation of nature, technology is the application of scientific knowledge and principles to solve human problem.

Biology as one of the science discipline, deals with the study of living organism. By studying biology, the individual studies him or herself and other organism as living things, the interaction between them and the non living things. Such knowledge is used to better the life of the individual. In agriculture for instance, it is used to improve food production; in the area of health, to prevent and control diseases. These are paramount to the development of the society. Hence the national curriculum (1985), spells out the major objectives of the biology syllabus as preparing the students to acquire adequate laboratory and field skills in biology, meaningful and relevant knowledge in biology, ability to apply scientific knowledge to everyday life in matters of personal health and agriculture and reasonable and functional scientific attitudes.

Achieving these objectives therefore means that every citizen must be taught the subject to understand and master all the concepts. However, gender stereotypes seem to be a major impediment to the achievement of these objectives. Oludipe, (2012) agreed that gender bias is very prevalent in Africa and particularly Nigeria. He argued that in Nigerian, harder tasks are assigned to males while females are given the relatively easy and less demanding tasks. This problem also exists in our schools where Gbaje (2007) says teachers maintain gender stereotypic view of their students and thereby perceives science as being difficult for the female students.

Stefanelli (on line) confirms that teachers ask boys higher level questions and engage them in conversation in the classroom than girls. These makes girls develop negative attitude and also reduces their motivation to learn science. Similarly, because of the self Perception resulting from the fixed stereotype carried to school by the students (Oludipe, 2012), some girls tend to become nervous on sighting some animals, blood or even models of some human parts.

One other obstacle to the study of science and particularly biology by the girls is Culture. According to Oldham (2000) cultures tend to discourage the girls from studying science in some societies. For instance, there are cultures in some African societies which prohibit girls from touching or having close look at certain animals or plants for superstitious reasons. Thus, where it becomes necessary for such items to be used for learning activities, the girls are left out. All these contribute to the less participation and consequently low performance of girls compared to the boys in biology and science generally. The implication is that the contribution of women to the development of the society becomes restricted

Addressing this problem therefore, requires concerted effort of the teacher. Hence Gbaje (2007) suggests that teachers should give both boys and girls the opportunity to participate in the learning activities by giving all of them challenging questions while girls assigned leadership role to increase their confidence. This is because girls tend to learn best when they work together while boys learn best when challenged by peers

Also Adesoji and Babatunde (2005) posited that creating a conducive atmosphere characterized by freedom of speech and expression which allows classroom interaction and participation irrespective of gender will bridge the gender gap. Barton (1998), Howes (2002), Sinnes (2006) as cited by Bassey, Joshua and Asim (nd) also agreed that if males and females are given the same opportunity in scientific inquiry, they will produce exactly the same result in science. According to Tweed (2005), classroom climate and teaching strategies must provide every student an equitable opportunity and therefore, teacher should use the teaching method that provides the opportunity for all students to participate fully in class activities, discussions and investigation (National Science Teachers Association NSTA, 2003). In this case, teachers' pedagogical skills and knowledge becomes paramount. This is why Utulu (2007) stated that as an effort to reduce or put a stop to the gender disparity, the Girls Education Project (GEP) has it as one of its objectives, to develop technical capacity of teachers' pedagogical skills to create girl friendly environment that enhances the participation of girls and improve their learning outcomes.

Many teaching methods are available for the science teachers to use. Some of which include: Lecture, discussion, demonstration, inquiry, field trip, Laboratory, others include scaffolding, concept mapping, Think - list -pair- share, cooperative learning. Unfortunately however, because of the over loaded biology syllabus, the current practice is that teachers in secondary schools make use of lecture method which they feel helps them deliver large amount of information to the students within a short period of time. However, this method fails to yield good result because students at this level are not matured for the method and the individual difference that exists among them is ignored. More so, it does not allow for active participation and interaction of students in the teaching and learning process. This creates students' anonymity and therefore quenches their interest in the subject. Besides, the method creates room for gender stereotypes in the class. This is because the teacher who dominates in almost everything, exhibit gender stereotypes either consciously or unconsciously. For example, calling on boys to help hold instructional aids, clean the board or even to answer questions considered more difficult while girls to answer simpler ones or sometimes left out. These eventually make girls' loss interest thereby discouraging them from full participation in the study of biology. It also encourage rote learning which perhaps account for the inability of our school leavers to apply biological concepts in solving their daily life problem as well as that of the society.

The cooperative learning, though a non conventional method seems to lend itself to this contemporary situation, because Stefanelli (1996) opines that girls thrive in cooperative learning situations and are more likely to acknowledge others' contributions. Hence Scholars such as Slavin (1998), Okebukola (1989), Esiogbu (2011) recommended its use in teaching science. This is probably because as the students learn in small groups, they all participate fully in class activities; interact among themselves and the lessons become interesting to them.

Moreso, the opinion of NTI (2009) that in a situation where culture prohibits some students, other students may carry out the activities while they watch is believed to work well in cooperative situation. This is because since all group members must go together in order to succeed, such students will be very attentive when watching their team mates carry out the exercise. Eventually, they will be encouraged to participate fully when they observe severally that nothing happens to their mates who touch the organisms. This may also reduce or even eliminate the superstitious beliefs affecting the learning of science hence full participation of all students and therefore achieving gender parity.

Cooperative learning is a teaching method where students study in small groups in their classes. Eight types of cooperative learning methods According to Johnson, Johnson and Stanine (nd), have been researched and found to be effective in teaching different subjects in different parts of the world. These include Students Team Achievement Division (STAD), Group investigation, Jigsaw approach, Constructive Controversy, Learning Together, Team Accelerated Instruction, Team Group Tournament Cooperative Integrated Reading and Composition.

This study examined the two cooperative strategies: STAD and Jigsaw because the Problem in Nigeria today calls for the education that will impart knowledge as well as bring our youths together to see themselves as one united and responsible for the nation's building thereby doing away with the Ethnic and religious differences. In these methods, students work in small groups and depend on one another for success. This creates in them, the spirit of love, tolerance and collective responsibilities which they may grow up with.

The Students Team Achievement Division (STAD) and Jigsaw Method

Slavin and Associates developed this method at Johns Hopkins University in 1978. In this method, students are divided into a four members mixed ability group (i.e. 1 bright, 2 average and 1 weak students). It consists of regular cycle of activities. First the teacher presents the lesson to the class using the traditional method. Then students in their groups work together and help one another to master the material by studying the materials and complete the worksheet together. According to CoeDubey, Dubey and Ndagi (1985), the brilliant students are expected to assist the weaker ones or those with learning difficulties. This is a way of reducing the gap in achievements of students due to individual difference in the class.

The jigsaw method was developed by Elliot Aronson and associate. In this method, the students are divided into small groups of five or six each (called the Jigsaw groups) and the concept to learn is broken into segments or subtopics. Each student in the jigsaw group is assigned a segment to specialize on as all students with same topics form expert groups. After the session, they reconvene in their jigsaw groups where each expert explain his /her topics to other members after which they take up quiz individually without help from group members. The scores of individual members are summed up to form the group scores which is used to reward the best group. In this method, each piece- each student's part is essential for completion and full understanding of the material. Because each student's part is essential, each student is equally essential.

The success story of cooperative learning is predicated on the Maslow's theory of needs hierarchy, that the students' love and acceptance by peers in their various groups motivates them to learn. Also by observing other group mates, those students prohibited by culture

observe, imitate and eventually join them in the activities. This agrees with Bandura's social learning theory.

However, empirical literature available on the method revealed conflicting reports on gender influence on academic achievements. For example, Abdullahi and Duyilemi (nd) compared the relative effectiveness of cooperative and competitive teaching methods in teaching biology at the secondary school showed that girls performed better than boys in cooperative learning method. Similarly, Kolawole (2008) carried out a study to investigate the effects of competitive and cooperative learning strategies on academic performance of Nigerian students in mathematics and reported that boys performed significantly better than girls in both learning strategies. One other study by Adeyemi (2008) on the effects cooperative learning and problem solving strategy on the achievement of Junior Secondary School social studies students shows that the effect of the teaching methods was gender sensitive. Also the study by Ajaja and Eravwoke (2010) aimed at determining how cooperative learning affects students' achievements in integrated science and how moderating variables such as sex and abilities influences students achievements in cooperative leaning shows that difference in the achievement between males and females was not significance in the cooperative learning group.

Although cooperative learning has been recommended for teaching biology, with these conflicting reports, it may be a costly mistake to claim that success will be recorded in the area of study without empirical support. Moreso, no study on cooperative learning particularly comparing the effect of the different methods on gender achievement in biology has been conducted in the study area. This study therefore investigates the effect of gender on the achievement of secondary school Biology students taught using two (STAD and Jigsaw) Cooperative learning methods in Wamba Local Government Area of Nasarawa state with a view to making them popular for use by teachers to address the gender disparity towards achieving the MDGs Education for All.

Research Questions and Hypotheses

The study is guided by these questions:

- (i) To what extent does gender influence the achievements of biology students taught using Jigsaw cooperative learning methods.
- (ii) To what extent does gender influence the achievements of biology students taught using STAD cooperative learning methods

The following null hypotheses served as guides to the study:

Ho₁: There is no significant difference between the mean achievements of male and female students taught biology using Jigsaw teaching method.

Ho₂: There is no significant difference between the mean achievements of male and female students taught biology using STAD teaching method

Method

The research adopted the non randomized, pretest – posttest control group quasi experimental design. Data was collected from a sample of 188 SS1students comprising of 95 boys and 93 girls from 6 randomly selected schools. A 30 item instrument called Biology Students Achievement Test (BSAT) was developed by the researcher and validated by two experts on test and measurement and one experienced biology teacher for construct and content validity respectively. The instrument was pilot test in one of the schools not included in the study and data collected was used to establish a test - retest reliability coefficient of 0.84 using Kuder-Richardson formula 21. The schools were grouped into 3 with 2 schools per group and assigned randomly into control 1 and experimental 2 groups. Three graduate biology teachers with at least five years of teaching experience were trained using the training package developed by the researcher. Each assistant was assigned a group to teach using the assigned method. The control was taught using the Lecture method while the two (STAD and Jigsaw) cooperative learning were used in experimental groups. Intact classes were used in all the schools in order

not to disorganize the schools' set up which the principals would not allow. Prior to the study, the students were pre tested using the BSAT and this was followed by treatment for 6 weeks after which they were post tested using the reshuffled BSAT. Data collected were analyzed using Mean, Standard deviation, ANCOVA at 0.05 level of significance.

Results

Research question 1: To what extend does gender influence the achievements of biology students taught using Jigsaw cooperative learning method?

Table1: The means and standard deviations of males and females students' scores exposed to Jigsaw method

Gender		Pretest	Posttest	Mean Gain
Male	Mean	13.4118	39.0588	25.647
	N	34	34	
	SD	4.73618	9.47386	
Female	Mean	11.4615	37.1538	25.6923
	N	26	26	
	SD	3.81818	6.64946	
Mean Gain Difference				0.0453

Table 1 shows that gender has no influence on the achievements of the students taught using Jigsaw method (the mean gain difference = 0.0453 in favour of females). The posttest SD of the females is lower than that of the males, an indication that the individual mean for male students in STAD deviated more from the group mean than that of females.

Research Question 2: To what extend does gender influence the achievements of biology students taught using STAD method?

Table 2: The means and standard deviations of males and females students' scores exposed to STAD method

Gender		Pretest	Posttest	Mean Gain
Male	Mean	14.2143	44.3571	30.1428
	N	28	28	
	SD	4.49985	7.32431	
Female	Mean	13.2353	45.4118	32.1765
	N	34	34	
	SD	3.87735	5.77412	
Mean Gain Difference				2.0337

Table 2 shows that the mean gain of the females is slightly higher than that of the males (mean gain difference of 2.0337). This indicates that the performance of female students is a little higher than the males. The posttest SD of females is lower than that of the males, an indication that the individual mean for male students in STAD deviated more from the group mean than that of females.

Hypothesis 1: There is no significant difference between the mean achievements of male and female students taught biology using Jigsaw method.

Table 3. ANCOVA tests of between subjects effects for male and female students exposed to Jigsaw method

Source	TypeIII squares	sum of	df	mean squared	F	sig.	Remarks
Corrected model	62.761		2	31.381	.441	.646	
Intercept	8704.637		1	8704.637	122.269	.000	

Pretest	9.295	1	9.295	.131	.719	NS
Gender	41.777	1	41.777	.587	.447	
Error	4057.972	57	71.192			
Total	91828.000	60				
Corrected Total	4120.733	59				

a. R Squared = .015 (Adjusted = -.019); S = Significant, NS = not significant

From Table 3, the F value for gender is .587 at degrees of freedom 1 and 59 and it is not significant at .447 [$F_{1,59}=.587$; $p > 0.05$]. The Null hypothesis is therefore retained. This means that there is no significant difference between mean achievement of male and female students taught using Jigsaw method

Hypothesis 2: There is no significant difference between the mean achievements of male and female students taught biology using STAD method.

Table 4: ANCOVA tests of between subjects effects for males and females students exposed to STAD method

Source	Type III sum of squares	df	mean squared	F	sig.	Remarks
Corrected model	17.163	2	8.582	.199	.820	NS
Intercept	10287.606	1	10287.606	238.160	.000	
Pretest	.085	1	.085	.002	.965	
Gender	16.559	1	16.559	.587	.447	
Error	2548.578	59	43.196	.383	.538	
Total	127756.000	62				
Corrected Total	2565.742	61				

a. R Squared = .007 (Adjusted = -.027); NS = Not significant

From Table 4, the F value for gender is .383 at 1 and 61 degrees of freedom and is not significant at 0.538 [$F_{1,61}=.383$; $P > 0.05$]. This means that there is no significant difference in the mean achievements of male and female students taught using STAD. Therefore the Null hypothesis is retained.

Discussion

The study investigated the effects of Jigsaw and STAD cooperative learning methods on the achievements of male and female secondary school biology students. The result shows that no significant difference exists in the mean achievement of boys and girls in both methods. Thus Table 1 shows that the achievements of male and female students is similar in the Jigsaw method (mean gain difference = 0.0453) while Table 2 shows a slight increase in the achievement of the females over the males in the STAD method (mean gain difference = 2.0337). However, Tables 3 and 4 shows that the difference is not significant which agrees with the findings of Peklaj (2003), Ajaja and Eravwoke (2010), Muraya and Kimamo (2011) and Oludipe (2012) which revealed gender equality in the mean gain in the cooperative learning method and also in line with the assertion of Etukudo (2002) cited by Kpaji (2011) that a good teaching method should be able to neutralize gender difference. It however, contradicts the findings of Adeyemi (2008) which shows that cooperative learning method is gender sensitive. Considering the mean gain difference of STAD, the result agrees with that of Abdullahi and Duyilemi (nd) that girls performed better than boys in cooperative learning method and disagrees with Kolawole (2008) which shows that boys performed better than girls. The superiority of the STAD is expected because the students worked together in mixed ability groups to complete their worksheets. Here the brilliant students pulled the average and the weak ones so that at the end all of them achieved. Moreover, by presenting the materials in brief, the teacher provided the background as well as the focus for the students so that completing the worksheet was easy.

The slight inferiority of Jigsaw to STAD however, is probably because in the Jigsaw group, students worked in groups irrespective of their abilities. It might be possible that some Jigsaw groups have all members being dull. Such groups could not understand what they discussed in their expert groups thereby misinforming themselves in their Jigsaw groups when they reconvened. Another probable cause of the weakness of Jigsaw method is that since students were left on their own to search and study materials, they might have wasted much time searching for the materials and has little time left to study and master the topics. One other reason according to Al-badawi (2008) is that for Jigsaw to succeed, students must interact and treat each other as resources. It is possible that students were not used to working together cooperatively and were not able to treat each others as resources.

Conclusion

The result of this study revealed that the achievements of male and female students are the same in the Jigsaw method but differ slightly in favour of the females in the STAD method. This difference is however, insignificant. This indicates that if these two methods especially the STAD are used properly to give the girls opportunity to participate, they will perform even better than boys and the issue of gender advantage of boys over the girls that exists in biology classes and science in general as reported by scholars would be a thing of the pass. This will encourage the girls to study science and the popular outcry on the low enrolment of girl child in the science and related fields such as medicine, pharmacy, Engineer, agriculture and architecture would be put to rest.

Recommendations

Based on the findings, the following recommendations are made to the major beneficiaries in the areas:-

- (i) Teachers should be trained on how to use the cooperative learning methods especially the STAD because it is more facilitative than the Jigsaw and be encouraged to use it in teaching biology for full participation and effective learning of biology by girls.
- (ii) Teacher trainees should be encouraged to master the methods so that they become used to them. Similarly, practicing teachers should be encouraged to go on in-service training while workshops, seminars and conferences should be organized to equip them with the knowledge of the STAD methods so that they will find them easy to use and therefore welcome them
- (iii) Book writers should review the biology textbooks by drawing out the activities in tune with the teaching methods so that both students and teachers can understand the concepts easily and better.

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