

EFFECTS OF COLLATERAL LEARNING STRATEGY ON THE ACHIEVEMENT OF SECONDARY SCHOOL STUDENTS IN SOME BIOLOGY CONCEPTS IN MINNA METROPOLIS

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Abstract: The study investigated the effects of collateral learning strategy on achievement of secondary school students in some biology concepts in Minna metropolis. A quasi-experimental, non-equivalent, non-randomized, pre-test, post-test, control group design was employed using only the senior secondary (SS2) biology students. A research instrument of 20 multiple choice items on genetics concepts was self-developed and was trial-tested, and the reliability co-efficient obtained was 0.68 using the KR-21 formula. The research instrument was Genetics Achievement Test (GAT) was validated by experts from science education and biological sciences. Data collected were analyzed using mean, standard deviations and Analysis of Covariance (ANCOVA). The finding revealed that teaching and learning genetics concepts using collateral learning strategy significantly increased academic achievement of the students. Findings also revealed that there was significant difference in the mean achievement scores of students taught using collateral learning strategy (CLS). The result also reveals that there is no significant interaction effect between CLS and gender on students' achievement scores. The researchers, therefore, recommends seminars, symposia, workshops and trainings should be encouraged towards effective teaching and learning in science education.

Keywords: Collateral Learning Strategy, Achievement, Science Education, Genetics Concepts

Introduction

Collateral learning strategy is the cognitive explanation of border crossing (Abu, 2008). According to Nsofor (2009), collateral learning is a strategy that enables learners to understand Science concepts while maintaining their world view. The task of science teaching is to help all children acquire scientific knowledge, interest, Skills, attitudes and ways of thinking without violating their cultural beliefs and experiences (Herbert, 2008). Ogunkola and Olatoye (2010) delineated Herbert's idea by proposing three types of Science namely: personal Science (the result of personal beliefs); indigenous Science (the communal beliefs and experiences of a micro-culture or cultural knowledge); and western modern Science. Abdulrahman (2010) argued that teaching western modern Science is enhanced when students become aware of their personal and indigenous Sciences in a classroom. He referred to this as 'Multi Science Teaching'. Science classroom presents challenges to students of various kinds and part of this challenge arise from cognitive conflicts that students feel in trying to reconcile their everyday life- world concepts with that of Science. The indigenous concepts may have developed from common sense or from direct experiences and/or the culture when these contrast with concepts learnt in the western Science classroom, the student is faced with the task of constructing a new concepts in the long- term memory. The student is said to indulge in collateral learning if he/she is able to hold two or more contrasting concepts in the long-term memory. Learning Science (biology) meaningfully according to Aikenhead (2006) often involves cognitive conflicts of some kinds. In collateral learning, students achieve meaningful learning as it takes the account of the multidimensional cultural world of the learner and helps him/her to resolve an existing conflict from different cultures. The stereotype in gender by different cultures also might have some effect on students' performance especially in science. Findings on the influence of gender on the performance of students in Science have not been conclusive. Gender issues too have been linked with performance of students in academic tasks in several studies but without any definite conclusion. The literature on gender differences as it related to Science is very replete.

Mankilik and Umanu (2009) reported that female perform poorly in Science than their male counterpart. Cimer (2012) revealed that there is no significant difference in the performance of male and female students in Science concepts, hence both performed equally, therefore, gender have no effect on academic performance. Bichi (2008) showed that male students perform better than female students in sciences and technological concepts. Researches on the influence of gender and cognitive achievement and retention- levels on the performance of the students in biology have been lingering. In view of the its importance, tremendous emphasis in science education has been centered on developing strategies or techniques which will help enhance students' acquisition of requisite skills, understanding and retention of science concepts. The objective of the National Policy on Education (Federal Republic of Nigeria, 2004) is to help students to become intellectually and effective teachers with good mastery of content and method for effective teaching of biology in senior secondary schools and colleges of education. However, the chief examiners of biology in senior secondary schools and colleges of education. The report of 2000 to 2007 revealed that only 20% to 30% of the students pass biology annually. The report attributed to this poor performance in biology to low performance in genetics concept among others and visible improvement is not yet in sight. This is of great concern to the researcher. If this trend is not checked, the result is that the teaching of biology in senior secondary schools and development of science in the nation will be affected. Students can learn if well taught but no teacher can give what he does not have when teaching. This situation calls for intervention in method employed by teachers. This has necessitated the need to employ strategies for improving teaching and learning of students in genetics. The strategy considered in this study for improvement is Collateral Learning Strategy (CLS). Although CLS is purported to have the potential to enhance students learning, it is not quite clear whether CLS may be more effective in achieving better learning outcomes and sustain students achievement and retention in genetics.

Purpose of the study

The purpose of this study was to determine the effects of collateral learning strategy (CLS) on secondary school students' cognitive achievement of secondary school students in some biology concepts in Minna metropolis. Specifically the study sought to:

1. Determine the effects of collateral learning strategy on achievement of secondary school students in genetics concepts.
2. Determine the influence of gender (Male and Female) on the achievement of students taught using collateral learning strategy and lecture method in genetics concepts.
3. Determine the interaction effects of treatment and gender on the mean achievement score of students in genetic concepts using collateral learning strategy.

Research questions

1. What is the mean achievement score of students taught genetics concepts using collateral learning strategy and those taught using lecture method?
2. What is the achievement score of male & female students taught genetics concepts using collateral learning strategy?

Research hypotheses

- H_{01} : There is no significant difference in the mean achievement score of students exposed to collateral learning strategy and those exposed to lecture method.
- H_{02} : There is no significant difference in the mean achievement score of male and female students exposed to collateral learning strategy and those exposed to lecture method.
- H_{03} : There is no significant interaction effect of treatment and gender on the mean achievement score of students in genetics concepts.

A quasi-experimental, non-equivalent, non-randomized, pre-test, post-test, control group design was employed using only the SSII biology students. The design was most appropriate since two intact classes were used and no randomization was done in the selection of the subjects. Pre-test was given to the students before the lessons and after the lessons Post-test was administered. The experimental group was taught using collateral learning strategy while the control group lessons were taught with lecture method. The independent variables are: collateral learning strategy and lecture method, the dependent variables is achievement on selected genetics concepts in biology and two levels of gender stood for moderating variables in this paper. The study was carried out in Niger State, specifically Minna Metropolis. In Minna Metropolis there are two Local Government Areas involved, which are Bosso and Chanchaga with their headquarters at Maikunkele and Minna respectively. The population of this study consists of all Senior Secondary II students (SS II) who offered Biology in all the 250 Secondary Schools owned by the Niger State Government during 2011/2012 session in which 34 schools are in Minna Metropolis. There were 61,442 students in the public secondary schools in Minna Metropolis (Niger State Ministry of Education, Planning, Research and Statistics Section, 2012). The research sample for this study was made up of 120 SS 2 students (60 males and 60 females). In the first stage, a purposive sample was adopted to sample four (4) co-education senior secondary schools because the schools are equivalent in the mode of admission or enrolment pattern. The researcher selected these schools in order to have subjects with same educational background. The considerations for comparable educational standard were: teachers were recruited by the same body using set down criteria by the state ministry of education. The same state government funds and supplies science equipment and other teaching resources to the schools on an equitable basis. The schools use the prescribed West African School Certificate (WASSCE) Examination Syllabus for Biology. The instrument used for this study was the Genetics Achievement Test (GAT), which consists of 20 multiple choice objective items adopted from the past senior secondary school certificate examinations of West African Examinations Council (WASSCE) and the National Examinations Councils (NECO) question paper from 2001 – 2012. In scoring the multiple choice questions, each question was awarded one (1) mark for a correct option chosen and letter converted to percentage. To test the reliability a random Sample of 30 Senior Secondary Two (SSII) students from different schools for the study were used. The reliability coefficient of the instrument when computed using KR21 was 0.68. The tests were administered by research assistants who are Biology teachers in the sampled schools. A pre-test was administered to all the groups before treatment to determine the equivalence of both experimental and control groups. The next five weeks were used in administering the treatment on the experimental and at the same time teaching the control group with lecture method. The last week of the study was used to administer Genetics Achievement Test (GAT) to the groups as post-test. The experimental group was taught collateral learning strategy where students were engaged doing things individually and advancing to the desired goal. The control group is otherwise the lecture method. The following statistics techniques involving the mean and standard deviation were used in answering the research question, as well as analysis of co-variance (ANCOVA) was used to test the Hypotheses formulated and analyze the data collected for the study at $P < 0.05$ probability level.

Results

Table 1: Mean Achievement Scores and Standard Deviations of Students Who Were Taught Using Collateral Learning Strategy and Those Taught Using Lecture Method

Groups	N	Pre-test		Post-test		Gain Scores
		Mean	SD	Mean	SD	
Experimental	60	30.0500	9.6926	68.1667	16.4956	8.7167
Control	60	30.9833	10.1656	59.4500	16.8547	

Table.1 shows the scores of students who were taught using collateral learning strategy (experimental group) and those taught using lecture method. Those who were taught genetics concepts using collateral learning strategy had mean achievement score of 68.1667 in the post-test making the mean achievement gain of the experimental group to be 8.7167. On the other hand, those who were taught genetics concepts using lecture method (control group) had mean achievement score 59.4500 in the post-test. This implies that teaching genetics concepts using collateral learning strategy significantly increased academic achievement of the students.

Table 2: Mean Scores and Standard Deviations of Male and Female Students Taught Genetics Concepts Using Collateral Learning Strategy

Groups	Gender	N	Pre-test		Post-test		Gain Score
			Mean	SD	Mean	SD	
Experimental	Male	31	38.7500	8.1093	65.6129	15.9701	5.2837
	Female	29	38.2414	10.1406	70.8966	16.8869	

Table 2 shows the mean achievement score of male and female students taught genetics concepts using collateral learning strategy and those taught using lecture method. For the experimental group, males had mean achievement score of 65.6129 in the post-test. The female students in the experimental group had mean achievement score of 70.8966 in the post-test making the mean achievement gain score of 5.2837. The female students in the experimental group had higher achievement than their male counterpart.

Table 3: Summary of ANCOVA Table of Students' Scores in the Genetics Achievement Test (GART)

Source	Type III Sum of Squares	df	Mean Square	F	sig.	Remarks
Corrected model	31912.736	85	375.444	4.012	0.000	
Intercept	11448.527	1	11448.527	122.334	0.000	
Pretest	210.645	1	210.645	2.251	0.143	NS
Gender	33.071	1	33.071	0.353	0.556	NS
Treatment	714.981	1	714.981	7.640	0.009	S
Gender * Treatment	17.872	1	17.872	0.191	0.665	NS
Error	3181.855	34	93.584			
Total	523675.000	120				
Corrected Total	35094.592	119				

S = significant at 0.05 probability level NS = not significant at 0.05 probability level

Table 3 shows the ANCOVA analysis of F (7.640) on achievement was significance at 0.009 which $p \leq 0.05$ alpha level at 1 degree of freedom is statistically significant. Therefore null hypothesis was rejected. This meant that there was significant difference in the achievement of students' taught genetics concepts using collateral learning strategy and those taught with the lecture method.

The table also revealed that the value of significance of F (0.353) on the mean achievement score of the students in the experimental group for gender is 0.556 against the level of $p \leq 0.05$ level of hypothesis of no significant difference in the mean achievement scores of male and female students taught genetics concepts using collateral learning strategy is therefore not rejected. This shows that gender is not a significant factor in the achievement scores of students who were taught using collateral learning strategy.

The table also shows ANCOVA results for two way interactions. It can be observed that the significance of F (0.191) for the two way interactions (treatment* gender) is 0.665 which is higher than $p > 0.05$ alpha level of significance. Therefore, the null hypothesis was accepted. That there is no significant interaction effect between CLS and gender on students' achievement scores.

Findings and discussion

1. *Students' achievement in genetics concepts due to the collateral learning strategy used:* Table 1 shows that CLS used in teaching genetics concepts have improved in students' achievement. This finding is similar to those in other studies in science education such as Kopksal & Cimen (2008), Imhanlahimi & Aguele (2006) where treatments improved students' achievement. This finding is also in agreement with the findings of Oludipe & Oludipe (2010) who recommended that appropriate teaching method be adopted in our classrooms with thematic instructional approach, which leads to students' improvement in mathematics achievement.
2. *Students' achievement in genetics concepts due to gender:* Table.3 shows that male students had a mean post GART score of 65.6129 as against the pre-test GART score 38.7500. Also female students score a mean post-test GART of 70.8966 as against pre-test GART of 38.2414. There is a slight variance in the post GART score of male and female students in the experimental group indicating that both male and female students benefited. Invariably when this result is compared with those of the male and female students in the experimental group, it can be seen that male and female students in the experimental group scored a higher mean post GART than those of the control group. This shows that male and female students in the experimental group appeared to achieve more in the Genetics Concepts taught. In further confirmation that gender is not a significant factor in students' achievement in genetics concepts is indicated in Table 3. The implication is that a good instructional strategy can facilitate both male and female students benefit at equal proportion in genetics concepts achievement. This further shows that these new learning strategy is gender friendly, therefore bridge the gap between male and female students' achievement in genetics concepts and science education in general, as noted in earlier studies such as those of Alhassan (2012), and Salahudeen (2012) as cited in Gana (2013).
3. *Interaction effects of treatment and gender on the mean retention of score of students in genetics concepts:* From the result on Table 3, the ANCOVA test revealed the significance of F at 1.327 against the already set alpha level of significance of $p \leq 0.05$ in the 2-way interaction. The implication is that there is no significant interaction between teaching method and gender on students' achievement in genetics concepts taught during the study. This finding is in agreement with Oludipe & Oludipe (2010).

Conclusion

This result may have been due to the use of collateral learning strategy which involves students or learners understanding science concepts while maintaining their world view. In collateral learning, students achieve meaningful learning as it takes the account of the multidimensional cultural world of the learner and helps him/her to resolve existing conflicts from the different cultures. Finally, the findings of the study imply that male and female students benefited equally in the achievement of genetics concepts taught during the study.

Recommendations

1. Seminars, symposia, workshops and trainings should be encouraged towards effective teaching and learning in science education
2. Collateral learning strategy should be encouraged in teaching secondary school students.
3. Gender friendly learning strategies should be imposed to bridge the gap between male and female students' achievement in genetics concepts and science education

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