

EFFECTS OF GUIDED INQUIRY INSTRUCTIONAL STRATEGY IN COOPERATIVE AND INDIVIDUALIZED LEARNING SETTING ON SECONDARY SCHOOL STUDENTS ACHIEVEMENT IN BIOLOGY IN ABUJA MUNICIPAL AREA COUNCIL

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Abstract

This study investigated the effects of guided inquiry instructional strategy in cooperative and individualized learning setting on secondary school students' achievement in biology. Also, examined was the influence of gender on the performance of students exposed to guided inquiry instructional strategy in cooperative setting. The research was a pretest posttest control group design. The sample for the study comprises 40 senior secondary school students (SSSII) randomly drawn from two private secondary schools in Abuja Municipal Area Council (AMAC), Abuja, Federal Capital Territory (FCT) Nigeria, the schools serve as experimental and control group respectively. The experimental group was taught using Guided inquiry instructional strategy in a cooperative setting while the control group was taught guided inquiry in an individualized setting. The instrument "Genetics Achievement Test (GAT)" which was validated and its reliability coefficient found as 0.80 was administered to the experimental and control group as pretest and posttest, the scores were subjected to t-test analysis. The findings of the study showed that the experimental group performs better than their counterpart in the control group. However, no significant difference existed in the performance of male and female students' exposed to Guided inquiry instructional strategy in a cooperative setting. Based on the findings it was recommended that there is need to encourage cooperative learning environment in science classes.

Keywords: Guided inquiry, Cooperative setting, Individualized setting and Achievement.

Introduction

Science, technology and mathematics (STM) occupy a central position in the evolution of modern world in the 21st century. They have transformed every aspect of human endeavor; Agriculture, Business, Education, Health, among others. Hence, nations of the world continue to strive to ensure a steady improvement in their science curriculum in the classroom. Biology as a subject occupies central position in many science courses such as medicine, pharmacy, agriculture, nursing, just to mention a few. In spite of the importance and popularity of science Biology indeed science to mankind, the performance of students at senior secondary school level has continued to be poor (Ahmed 2008) in Yusuf and Afolabi (2010). As a result of poor performance in science, the attentions of researchers have been focused on the causes of the poor performance. The factors responsible for poor performance in science have been identified to include lack of instructional materials and science equipment (Shaliu 2004; Yusuf, 2004), and

poor use of traditional method of teaching (Biodun 2004; Bajah 2010 & Okebukola, 1999). Yusuf (2010) observed that students perform poorly in biology because the biology classes are usually too large and heterogeneous in terms of ability level, just to mention a few.

Using traditional teaching method in teaching science allowed students to assimilate instructional content at knowledge level of the cognitive domain only and they usually memorize what they learnt without understanding of what is taught. Thus, this tends to affect students academic achievement and attitude towards science. The search for effective instructional strategies and the need to try some students-centred method of teaching have been the theme in different science fora nationally and internationally. Methods that promote active learning or learning by doing. Since science is inquiry (Ramalingam, 2001) then, for one to understand and learn science, there is the need to approach it by the inquiry method. Teaching science using inquiry method involves teaching students to solve problems using science process skills in a logical and systematic way. Polman, (1998); Timothy and Awodi (1997) and Obeka (2010) observed that inquiry based learning is gaining increasing support in science education, with a growing number of educators becoming interested in teaching inquiry strategy. The most important feature of this method is that it enables learners to be researchers and problem solvers. Furthermore it makes students active and improve their research skills (Metz, 2004; Wallace et al, 2004) in Bilgin, (2009).

Research evidence on guided inquiry by Agboghoroma (2005) & Obeka, (2010) among others concluded that the use of guided inquiry instructional strategy results in higher achievement than the use of conventional method. For instance, Timothy and Awodi (1997) investigated the relative effects of inquiry and lecture methods on the performance of high and low achievers in senior secondary school biology. Their findings showed that inquiry method improved the performance of low achievers students in biology and female students performed better than their male counterparts. Hence, this study seeks to investigate the effect of guided inquiry instruction in individualized and cooperative setting.

Learning setting in either cooperative or individualized may be a significant factor in students' performance in science. Cooperative learning is an instructional method in which students are required to work together on a learning task (Harasim 1997) in Gambari, (2010). In cooperative learning, members share skills, knowledge, experiences and materials with one another which lead to achievements of set objectives. Cooperative learning has been widely researched and findings have shown that cooperative learning produced positive effects on

students' achievement (Yusuf 2004; Adeyemi, 2008 & James, 2008). Students engage in cooperative learning, work together to achieve group goals leading to positive interpersonal relationship that cannot be achieved in individual or competitive setting. (Bailey, 2008; Eskilsson, 2008 & Bilgin, 2006) in Ibrahim, (2009) found that when teaching materials are used in cooperative learning environment, students' performance better in science concepts.

Aluko, (2010), investigated the effects of cooperative and individualistic instructional strategies on students' problem solving abilities in secondary school chemistry in Nigeria and found that the cooperative group performed better than individualistic instructional strategy. However significant difference was found on the performance of male and female students exposed to both cooperative and individualistic instructional strategy. In individualized Instructional setting, the computer will present instructions interactively with one student only. Students enter an individualized process and proceed at their own pace. Question will be given to each student after each sequence of instruction and individual members of the class will be expected to provide answers to the questions without any interaction. The teacher's role is to monitor the activities of the students so as to ensure strict compliance with instructions.

The under achievement of students in biology at senior secondary school certificate examination is a source of concern to all stake holders in the Nigeria education system. The poor performance has been attributed to poor teaching methods (Mathew, 2002; Olorukoba, 2007), abstract nature of science concepts (Biology inclusive) (Nsofor, 2006 & Shehu, 2006). Findings on the influence of gender on the performance of students in science have been inconclusive. Ifamuyiwa (2004) and Iwendi (2009) reported that male students performed better than their female counterpart in science and mathematics concepts while some researchers found that female students perform better than their male counterpart (Olson, 2002 & Anagbogu & Ezeliora 2007). Research reports from Adeyemi (2008), Ifamuyiwa and Akinsola (2008), revealed that there is no significant difference in the performance of male and female students.

Genetics concepts in biology are among the difficult concepts as perceived by students (Katto 2004).

Table 1: Genetics Concepts Perceived as Difficult by Students

S/N	Items/concepts	Correct conceptions		Misconceptions	
		number and (%)		number and (%)	
1.	MUTATION	25	(20.8%)	80	(66.7%)
2.	PHENOTYPE	30	(25.0%)	78	(65.0%)
3.	GENOTYPE	30	(25.0%)	80	(66.7%)
4.	GENES	40	(33.3%)	71	(59.2%)
5.	CHROMOSOMES	33	(21.5%)	70	(58.3%)
6.	RECESSIVE CHARACTER	31	(25.8%)	66	(55.0%)
7.	DOMINANT CHARACTER	40	(33.3%)	67	(55.8%)
8.	HEREDITY	50	(41.7%)	58	(48.3%)
9.	FILIAL GENERATION	20	(16.7%)	52	(43.3%)
10.	ZYGOTE	40	(33.3%)	51	(42.5%)
Mean (\bar{x})		28.2%		56.1%	

Source: Katto, (2004).

From table 1 above, the average percentage misconceptions (56.1%) were higher than the percentage of correct conception (28.2%). Also the difficult concepts as reported by WAEC Chief Examiners report (2002 & 2005) included genetics. Hence the need for the search for alternative instructional strategy that will improve students conception and performance in genetics.

Research Questions

1. Are there differences in the performance of students taught genetics with guide inquiry?
2. Is there any difference between the mean performance of male and female students taught genetics with guided inquiry instructional strategy in a cooperative learning setting
3. Is there any difference between the mean performance of male and female students taught genetics with guided inquiry instructional strategy in an individualized learning setting

Research Hypotheses

- HO₁: There is no significant difference in the mean performance scores of student taught biology with guided inquiry in individualized setting and those taught in cooperative setting
- HO₂: There is no significant difference in the mean performance scores of male and female students taught biology with guided inquiry in cooperative setting.
- HO₃: There is no significant difference in the mean performance scores of male and female students taught biology with guided inquiry in individualized setting.

Methodology

The research design was a pretest posttest control group design. The population was all the twenty one senior secondary schools in Abuja Municipal area council (AMAC). The sample for this study was randomly drawn from two comparable co-educational secondary schools in Abuja Municipal Area Council in the Federal Capital Territory (FCT), Abuja. Preliminary investigations showed that the two schools were comparable in terms of academic standard, method of students' admission, recruitment of teachers, physical facilities and science laboratory equipment and materials. The subjects of this study 40 senior secondary school II students (SSS2) were randomly assigned into experimental group (n=20) and control group (n = 20). Students in the experimental group were instructed with Guided Inquiry in a cooperative learning setting, while students in control group received Guided Inquiry in an individualized setting. The main differences between the two instructional approaches are that students in the experimental group discussed all models, critical questions, exercises and problems cooperatively in small groups, while students in the control group, read and did all questions, exercises and problems individually in class.

The instrument for this study was Genetics Achievement Test (GAT). The (GAT) is composed of 25 item multiple choice question which covered the following topics: Heredity, genes, chromosomes, cross breeding, recessive and dominant characters. The objective questions were validated by two science education lecturers and one senior Biology teacher. The reliability of the instrument was found to be 0.80.

Research Procedure

The study lasted for 6 weeks, the experimental and control groups were given GAT as pretests at the beginning of the study. Both groups gained experience with guided inquiry instruction in Genetics concepts. In the control group, students studied teaching materials in class individually thereafter the teacher randomly called student to share their findings with the class. In the experimental group, the students were assigned to four member-learning teams in a small group-learning environment. The experimental group was trained about cooperative learning approach and a detailed description of the cooperative learning approach was distributed to all of the students before the treatment. Students in experimental group studied all of the teaching materials in class cooperatively. When groups completed their work for each question and reached a consensus, the teacher asked some members of the group to explain their answers during evaluation of the lesson. At the end of the treatment, both the experimental and the control groups were administered GAT as post-tests.

The data collected from pre and posttest were analyzed with mean, standard deviation and t-test using the Statistical Package for Social Science packages (SPSS) 17.0

Results

The analyses and interpretation of results are presented in table 1, 2, 3 and 4.

Table 1: t-test result of pretest scores

Group	N	df	Mean	SD	t-cal	Sig. (2-tailed)
Experimental	20		20.85	2.76		
		38			0.28 ^{ns}	0.78
Control	20		21.10	2.86		

ns: not significant at 0.05 level

t-test analysis of students' pretest scores of the experimental and control groups revealed that there is no significant difference $t = 0.28$; $p > 0.05$. This indicates that the initial mean score of the two groups were equivalent and that the subjects of this study were comparable.

Hypothesis one (H_{01}): There is no significant difference in the mean performance scores of student taught biology with guided inquiry in individualized setting and those taught in cooperative setting

Table 2: t-test results of the posttest scores of experimental and control groups

Group	N	df	Mean	SD	t-cal	Sig. (2-tailed)
Experimental	20		69.00	5.76		
		38			4.21*	0.01
Control	20		62.00	4.70		

*Significant at 0.05 level

The result of the analysis in table 2 shows the posttest achievement scores of experimental and control group. The posttest mean score are 69.00 for the experimental group and 62.00 for the control group. The experimental group score differ significantly from the control group scores. The experimental group has higher mean score than the control group ($t = 4.21$; $p < 0.05$) hence, the null hypothesis is rejected indicating that there is a significant difference between the achievement of the experimental and control groups.

Hypothesis one (H_{o2}): There is no significant difference in the mean performance scores of male and female students taught biology with guided inquiry in cooperative setting.

Table 3: t-test comparison of the posttest mean score of male and female students in experimental group

Group	N	df	Mean	SD	t-cal	Sig. (2-tailed)
Male	10		68.00	4.83		
		18			0.20 ^{ns}	0.84
Female	10		68.50	6.26		

Ns: not significant at 0.05 level

Table 3 indicates the posttest mean score of male and female students in the experimental group. The posttest means score are 68.00 for the male students and 68.50 for the female group. The male scores did not differ significantly from female scores when both were taught genetics using guided inquiry in a cooperative setting, ($t = 0.20$; $p > 0.05$) This shows that there is no significant difference between the posttest mean score of male and female students. Therefore, the null hypothesis is accepted.

Hypothesis one (H_{o3}): There is no significant difference in the mean performance scores of male and female student taught biology with guided inquiry in individualized setting.

Table 4: t-test comparison of the posttest mean score of male and female students in the control group

Group	N	df	Mean	SD	t-cal	Sig. (2-tailed)
Male	10	18	57.00	5.87	1.21 ^{ns}	0.24
Female	10		54.00	5.16		

ns: not significant at the 0.05 level

Table 4: shows the posttest mean score of male and female students in control group. The posttests mean score is 57.00 for the male students and 54.00 for the female group. The mean male score did not differ significantly from the mean female scores when both were taught genetics using guided inquiry in a cooperative setting, ($t = 0.21$; $p=0.24$; $p > 0.05$). This shows that there is no significant differences between the posttest mean score of male and female students, taught genetics using guided inquiry in a cooperative setting. On this basis the null hypothesis is accepted.

Discussion

The study sought the effects of guided inquiry instructional strategy in cooperative and individualized learning setting on secondary school students' achievement in biology. Data collected were analyzed using t-test statistics.

The results of the t-test analysis on the performance of student taught genetics using Guided Inquiry in co-operative and individualized learning setting revealed that there was significant differences in the post mean score of the experimental and control group in their academic achievement in genetics. As a result, the null hypothesis which states that there is no significant difference in the mean performance of student taught guided inquiry in cooperative setting and those taught individualized setting was rejected. In other words, those taught genetics using guided inquiry in a cooperative setting performed better ($X= 69.00$) than those taught genetics in an individualized setting ($X= 62.00$).

This result is in line with the findings of (Bailey, 2008; Eskilsson, 2008 and Bilgin, 2006), who found that when the teaching materials are used with cooperative learning environment, students' perform better in science concepts. These findings also agrees with the earlier findings of Yusuf (2004), Adeyemi (2008) and James (2008) among others, that co-operative learning produce positive effects on students achievement. This implies that activities used in

cooperative learning helped students to interact with the learning materials, share ideas and thereby enhanced.

Hypothesis Two was retained, signifying that there was no difference between the performance of the males and females of the experimental group taught genetics using guided inquiry in a cooperative setting. This finding agree with that of Adeyemi (2008), Ifamuyiwa and Akinsola (2008), which revealed that there is no significant difference in the performance of male and female students in science and mathematics concepts. This result disagree with the findings of Ifamuyiwa (2004) and Iwendi (2009) who reported that male students performed better than their female counterpart in science and mathematics concepts. The non significant gender related difference in performance could be attributed to the fact that both participated actively in the learning process thus helped them to acquire meaningful learning

Hypothesis Three was retained signifying that there was no difference between the performance of the males and females of the control group taught genetics using guided inquiry in an individualized setting. This finding agrees with the findings of Umar (2011), who reported that there is no significant difference in the performance of male and female students in biology. This also agree with the findings of Adeyemi (2008), Ifamuyiwa and Akinsola (2008) which revealed that there is no significant difference in the performance of male and female students in science. Hence individualized instruction seems to gender friendly.

Conclusion

The guided inquiry instructional strategy used in a cooperative setting is facilitative and proactive in promoting the acquisition of science skills and competences; it made the lesson activity based and enabled individual learners to interact among themselves. Hence, learning tasks requiring social interactions seem to stimulate learning. Guided inquiry in cooperative setting and individualized setting is not gender biased. The non significant gender related difference in performance could be attributed to the fact that fact that guided inquiry is a learner centered instructional strategy and it encouraged active learning rather than passive learning.

Recommendations

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

- (i) Necessary attention should be accorded active learning such as Guided inquiry in a cooperative setting in secondary schools and relevant cooperative learning strategies should be encourage especially among biology teachers.
- (ii) Students should be encouraged to develop social interaction among them in the classroom through cooperative learning.
- (iii) Stakeholders should regularly organize workshops and seminars for science teachers on how to organize and facilitate cooperative learning
- (iv) Since guided inquiry in cooperative and individualized setting is gender friendly, teachers should be encourage to use it in teaching in order to bridge the gender gap between male and females.

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