European Journal of Training and Development Studies
Vol.6 No.1, pp.13-28, January 2019
Published by European Centre for Research Training and Development UK (www.eajournals.org)

EFFECTS OF SOCRATIC QUESTIONING TEACHING STRATEGY ON THE ACHIEVEMENT OF PUBLIC SECONDARY SCHOOLS BIOLOGY STUDENTS IN LANGTAN NORTH, PLATEAU STATE, NIGERIA

Christine Agbowuro, Ph.D
University of Jos, Faculty of Education
Department Of Science and Technology Education

Mallam Danjuma Nanso
Gss Chwel-Nyap, Jos North, Plateau State

Ishaya Luka Maigoro
Kingdom Kids International Academy, Liberty Dam Road
Jos, Plateau State

Mantu Luka Mauchin
Ministry Of Education, Gss Jannaret Mangu, Plateau State

Oche Amarachi Jennifer
Starville School, Gwarimpa, Abuja

ABSTRACT: *The effect of Socratic questioning teaching strategy on the achievements of students on the concept of habitat was investigated. The design of the study was a quasi-experimental, specifically the pre-test post-test control group design. There are 14 public secondary schools in Langtang north with a population of 2740 students. Two schools were randomly sampled. One was randomly assigned to the experimental group and the other to the control group. They were used as intact groups. The sample was made up of 96 students, (50 males and 46 females). Four research questions were answered while six hypotheses were tested at 0.05 level of significance. The instrument used for data collection was a 30-item test. The instrument was validated and its reliability established at 0.84. The data collected was analyzed using mean, standard deviation and the t-test. Findings indicated that the Socratic teaching had significant effect on the students' performance. The use of the Socratic teaching strategy was recommended.*
KEYWORDS: Socratic, questioning, teaching, achievement, secondary, Biology. Students

INTRODUCTION

The act of asking questions and seeking answers is fundamental to all human creativity and willful living. Experiences of inquiry fill our days. Inquiry richly colors the fabric of how our minds work. Inquiry is the workhorse of the sapience. The Socratic Method directly addresses the need of students to exercise their experience and love of asking and answering questions in the context of daily learning, Columbo (2003) solves his mysteries by asking many questions; as do all the great detectives-in real life as well as fiction. All the great inventors and scientists asked questions. Isaac Newton asked, "Why does an apple fall from a tree?" and, "Why does the moon not fall into the Earth?" Charles Darwin asked, "Why do the Galapagos islands have so many species not found elsewhere?" Albert Einstein asked, "What would the universe look

Print ISSN: 2057-5238(Print), Online ISSN: 2057-5246(Online)

like if I rode through it on a beam of light?" By asking these kinds of fundamental questions they were able to start the process that lead to their tremendous break through. The great philosophers spend their whole lives asking deep questions about the meaning of life. We do not have to be quite so contemplative but we should nonetheless ask the deep questions about issues. Intelligent questions stimulate, provoke, inform and inspire. Questions help us to teach as well as to learn. Productive questions posed by the teacher at just the right time are also critically important to helping children construct their own understandings.

Teaching is the process of attending to people's needs, experiences and feelings and making specific interventions to help them learn particular concept. Interventions commonly take the form of questioning, listening, giving information, explaining some phenomenon, demonstrating a skill or process, testing understanding and capacity and facilitating learning activities, Smith (2014). The Socratic Method offers teachers a focus to raise their game by providing a way to exercise the best in a teacher so that they are much more than just a machine performing a function. Humanity desperately needs all teachers to be persons who possess unending vision and passion to live their own examined lives, and through the abundant fertility of their own journey, become a living inspiration in the classroom. Questions are the best way to gain deeper insights and develop more innovative solutions. Paul, Sloane, Dyke (2000). Students learn by asking questions. Innovators understand client needs by asking questions. It is the simplest and most effective way of learning.

Socratic method also known as maieutics method of elenctic method is a form of cooperative argumentative dialogue between individuals, based on asking and answering questions to stimulate critical thinking and to draw out ideas it is a dialectical method often involving a discussion. Questioning students is the most frequently used instructional strategy in classrooms (Tienken, Goldberg, and Dirocco, 2010). Teachers in classrooms across the world and at all levels ranging from pre-kindergarten to college utilize questions to gage what students do and do not know. The Socratic Method emerged when Socrates taught his student through asking questions in order to help them reach a new level of understanding. Socrates taught Glaucon to draw conclusions and think about his answers by posing questions that required his student to "reflect and think critically about the subject" (Tienken, et. Al., 2010, p. 28). Current societal demands require teachers to examine similar methods and improve the questions being asked. To help prepare students for success outside of the classroom, teachers must help students to draw their own conclusions and develop their own questions about the world around them (Shaunessy, 2000). Employing purposeful questions assist teachers with ascertaining all students' levels of understanding by allowing students the opportunity to illustrate gained knowledge and with helping students learning to think beyond basic recall questions.

Questioning gives teachers the opportunity to investigate their students' knowledge and understanding of objectives. Lessons often open with a question and questions are sprinkled throughout to aide in assessing understanding and comprehension as well as evoking the thought process for students. Teachers spend more than 90% of the class time questioning students, but the majority of these questions depends only on factual information and often requires only one correct answer (Khan and Inamullah, 2011). In order for teachers to truly engage students in classroom discussions, teachers need professional development in learning to develop their questioning techniques in the classroom for instructional and assessment purposes. Charles (2010) reminds educators that most teachers teach the way that they were taught which leads to the closed, lower-level thinking questions. The best way to raise the level

Print ISSN: 2057-5238(Print), Online ISSN: 2057-5246(Online)

of critical thinking in the classroom is to raise the level of questions by developing students' ability to critically analyze and evaluate the concepts and ideas being discussed in the classroom. In order to change the way teachers think about questioning students, teachers must be willing to experiment with new techniques and methods in developing questions, so schools must be willing to give support to teachers through professional developments and learning opportunities .

Statement of the Problem

A huge number of students are failing to master the desired competences due to a flawed teaching system, observes the World Bank. The global lender in a report states that the most common teaching method at secondary classes in the country is lecturing and reading of textbooks and when it comes to interaction, teachers only ask closed questions like "yes" or "no" to check whether the students have memorized the textbook information. This teaching practice goes hand in hand with current examination system, which test only memory recall from the textbook. The weakness of our teaching process is that it is not child centered. The differential scholastic achievement of students in Nigeria has been and still a source of concern and research interest to educators, government and parents. All over the country, there is a consensus of opinion about the falling standard of education in Nigeria (Adebule, 2004). Parents and government are in total agreement that their huge investment on education is not yielding the desired dividend. It is against this constraints that the researchers see the subject matter as an empirical problem worthy of investigation.

Purpose of the Study

The main purpose of this study was to determine the effect of Socratic questioning teaching strategies on the achievement of senior secondary two (SS2) Biology students in Langtang North of Plateau State. The specific objectives of this study will be;

1. To find out the most frequently used methods of teaching Biology in schools
2. To find the extent to which teachers use the Socratic questioning teaching method in schools
3. To determine the effect of Socratic questioning method and the lecture method on student's retention abilities
4. To examine the extent to which teachers' classroom questioning is related to students' level of answering questions in the classroom.
5. To find out whether students are given enough time to think and respond to questions.
6 To find out the extent to which students respond to the conventional method of teaching as well as the questioning approach
7 To examine the role of gender on teaching strategies in schools

Research Questions

The following research questions will be answered to provide solutions to the research problems.

1. What is the effect of Socratic questioning and lecture instructional strategies in improving students' achievement on the concept of habitat?
2. What is the effect of Socratic questioning and lecture strategies in improving students' retention abilities on the concept of habitat?

Print ISSN: 2057-5238(Print), Online ISSN: 2057-5246(Online)

3. What is the difference in the achievement of students of different sexes when they answer questions on the concept of habitat after exposing them to the Socratic questioning strategy?
4. What is the difference in the achievement of students of different sexes when they answer questions on the concept of habitat after exposing them to lecture method approach?

Research Hypotheses

The hypothesis will be tested at 0.05 level of significance in the course of the study.

1. There is no significant difference in the achievement between students taught with Socratic questioning strategy and those taught using lecture method
2. There is no significant difference in the retention abilities of students taught using Socratic questioning strategies and those taught using lecture method
3. There is no significant difference between the achievement of male and female students on the concept of habitat after exposing them Socratic questioning strategy
4. There is no significant difference in the abilities of male and female students when answering questions on the concept of habitat after exposing them to lecture method approach
5. There is no significant difference between male and female students' on the retention abilities on the concept of habitat after exposing them to Socratic questioning teaching strategy
6. There is no significant difference between and female students on the retention abilities on the concept of habitat after exposing them to the lecture approach

THEORETICAL/CONCEPTUAL FRAMEWORK

The theoretical/Conceptual frame work of this study is anchored on Irving Siegel question theory. Irving devoted his life to the importance of asking questions. He believed, correctly, that the brain responds to questions in ways that we now describe as social, emotional, and cognitive development. Questions create the challenges that make us learn. The essence of Irv's perspective is that the way we ask questions fosters students' alternative and more complex representations of stories, events, and circumstances, and their ability to process the world in a wider range of ways, to create varying degrees of distance between themselves and the basis events in front of them, is a distinct advantage to learning. However, Irving found that schools often do not ask the range of questions children need to grow to their potential.

Significance of the Study

The findings of this study will be beneficial in several ways to the biology teachers, science teachers, students as well as to the curriculum planners. This is because during Socratic questioning, the teacher is a model of critical thinking who respects students' viewpoints, probes their understanding, and shows genuine interest in their thinking. The teacher poses questions that are more meaningful than those a novice of a given topic might develop on his or her own.

The teacher creates and sustains an intellectually stimulating classroom environment and acknowledges the value of the student in that environment. In an intellectually open, safe, and demanding learning environment, students will be challenged, yet comfortable in answering questions honestly and fully in front of their peer as well as to possess the skills to participate when they are called upon and to answer questions as carefully and clearly as possible.This study will also serve as a useful source of information to other researchers who want to conduct similar studies. It will also help teachers towards mastering the desired techniques for effective teaching and learning

Print ISSN: 2057-5238(Print), Online ISSN: 2057-5246(Online)

METHODOLOGY

The research design adopted for this study was the Quasi-experimental pre-test, post-test of the non-equivalent control-group design was adopted, Intact groups were used. The pattern of the design is illustrated as follows:
Expt. 0_{11} x 0_{21}
Control 0_{12} x 0_{22}
In the illustration, 0_{11} and 0_{21} represent the pre- test of the experimental and the control group respectively. At this stage it is expected that $0_{11} = 0_{21}$ since the two groups were taught by the same teaching strategies. 0_{12} and 0_{22} represent the pos-test for the experimental and the control respectively. It is expected that at the end of the four weeks teaching period, since the students were subjected to different instructional strategies, 012 > 022 mean scores assuming that instructional strategies received by experimental group was more effective than that of the control group.The target population for the study comprised all public senior secondary school in Langtang North LGA. The choice of the SSI1 students was considered more appropriate because they would have be exposed to some basic Biology concepts and skills which would enable them solve problem in biology. In Langtang North LGA, there were 14 senior secondary school (public) with an estimated population of 2740 Boys and girls.

The sample consisted of 96 students from two intact classes, comprising 50 males and 46 female. The simple random sampling technique was employed. The instruments for data collection was the Biology Achievement Test
. Simple descriptive statistics were used to answer the research questions. The six hypotheses stated to guide the study were tested using t- test of independent samples, at 0.05 level of significance.

RESULTS AND DISCUSSION OF FINDINGS

The result obtained from the pre-test and post-test of the students' responses from the BAT were related, as shown below:

Table 1: Mean achievements and standard deviations of pre-test and post-test on Socratic questioning and lecture instructional groups.

Groups N = 96		Pre-test	Post-test	Gain in Mean
Socratic questioning	X	7.00	19.00	12.00
N = 50	SD	3.19	4.75	
Lecture method	Y	7.00	14.35	7.35
N = 46	SD	3.02	4.65	

N = number of students, X = Socratic questioning, Y = lecture method; Mean, SD = Standard deviation.

Table 1 shows the pre-test and post-test achievement of the Socratic questioning strategy and lecture instructional strategy group as well as their standard deviations. It could be seen that their achievement means were equal, suggesting that the students were academically and intellectually at the same level at the beginning of the research. The two groups scored differently (19.00 and 14.35 respectively, for the experimental and control groups) in the post-test. The research treatments resulted in gains of 12.00 and 7.35 mean score respectively.

Print ISSN: 2057-5238(Print), Online ISSN: 2057-5246(Online)

Research Question 1

What is the effect of Socratic questioning and the lecture instructional strategies in improving students' achievement on the concept of habitat?

Table 2: Achievement means and standard deviations of the Socratic questioning method and lecture method groups.

Group	N	X	SD
Socratic questioning method	50	19.00	4.75
Lecture method	46	14.35	4.63

N = number of students, X = ~~me~~an, SD = Standard deviation.

Table 2 shows that the mean differences between the two groups (Socratic questioning method and lecture method) were 19.00 and 14.35 respectively. This showed that students taught Socratic questioning strategy improved better in achievement than those using lecture methods. Therefore, the answer to research question 1 was that Socratic strategy had a greater effect in improving students' achievement on the concept of habitat than the lecture instructional strategy.

Research Question 2

What is the effect of Socratic questioning strategy and lecture method in improving students' retention abilities on the concept of habitat?

Table 3: Retention abilities mean and standard deviations of Socratic questioning strategy and lecture method groups.

Group	N	X	SD
Socratic questioning method	50	17.32	5.18
Lecture method	46	7.78	2.73

N = number of students, X = means, SD = Standard deviation.

Table 3 shows that the mean difference between the two groups (Socratic questioning and lecture strategies), were 17.32 and 7.8 respectively. This showed that students taught using Socratic questioning strategy improved better on their retention abilities than those taught using lecture method. Therefore, the answer to research question 2 was that Socratic questioning strategy in improving students' retention abilities on the concept of habitat.

Research Question 3

What is the difference in the achievement of students of different sexes when they answer questions on habitat after exposing them to the Socratic questioning strategy?

Table 4: Achievement means and standard deviation of male and female students' in Socratic questioning instructional strategy.

Group	N	X	SD
Male	23	19.00	5.35
Female	27	19.00	4.27

Table 4 shows equal means of male and female students of 19.00 which revealed that there was no difference on their achievement. This result shows that gender had no influence on the

Print ISSN: 2057-5238(Print), Online ISSN: 2057-5246(Online)

students' achievement when they answer question on habitat after exposing them to Socratic questioning strategy.

Research Question 4

What is the difference in the achievement of students of different sexes when they answer questions on the concept of habit after exposing them to lecture method approach?

Table 5: Achievement means and standard deviations of male and female Students' in lecture method.

Gender	N	X	SD
Male	28	13.75	4.45
Female	18	15.28	4.88

Table 5 shows that the mean between male and female students were 13.75 and 15.28 respectively. These results showed an increase in the achievement mean of the female students over that of the male students. Therefore, the answer to research question 4 was that gender has some influence on the achievement of students on the concept after exposing them to lecture instructional habitat strategy, in favour of the females.

TESTING OF HYPOTHESES

In this sub-section, the six null hypotheses generated for this study were tested, one after the other.

Hypothesis 1

There is no significant difference in the achievement between students taught with Socratic questioning strategy and those taught using lecture method.

Table 6: T-test analysis for achievement of post-test scores of Socratic questioning and lecture method instructional strategies in BAT.

Group	N	X	SD	t-critical	t-calculated
Socratic questioning method	50	19.00	4.75		
				2.00	4.86
Lecture method	46	14.35	4.63		

P < 0.05, df = 94In table 6, an independent t-test was conducted to compare the effect of Socratic questioning and lecture instructional strategies. The different scores for Socratic questioning (mean = 19.00, SD = 4.75) and lecture method (mean = 14.35, SD = 4.63), were subjected to t-test analysis. The value of t-calculated (4.86) was greater than the t-critical (2.00) and hence, hypothesis 1 was rejected.

Hypothesis 2

There is no significant difference in the retention abilities of students taught using Socratic questioning strategy and those taught using lecture method.

Table 7: T-test analysis for retention abilities test score on Socratic questioning and lecture method instructional strategies.

Group	N	X	SD	t-critical	t-calculated
Socratic questioning method	50	17.32	5.18		

Print ISSN: 2057-5238(Print), Online ISSN: 2057-5246(Online)

				2.00	11.41
Lecture method	40	7.78	2.73		

P < 0.05, df = 94

In table 7, data of an independent sample t-test conducted to compare retention of student taught the concept of habitat using Socratic questioning strategy and those taught using lecture instructional strategy are shown. The different scores in the retention abilities for Socratic questioning method (mean = 17.32, SD = 5.18) and lecture method (mean = 17.32, SD = 2.73) were subject to t-test analysis at 0.05 level of significance and df of 94. The value of t-calculated (11.41) was greater than the t-critical (2.00); hence, hypothesis 2 was rejected.

Hypothesis 3

There is no significant difference between the achievement of male and female students on the concept of habitat after exposing them to Socratic questioning strategy.

Table 8: T-test analysis of the influence of gender in students' post-test achievement scores after exposing them to Socratic questioning strategy.

Gender	N	X	SD	t-critical	t-calculated
Male	23	19.00	5.35		
				2.02	0.00
Female	27	19.00	4.27		

P < 0.05, df = 48

Table 8 shows an independent sample t-test which was conducted to compare the achievement of male and female students after exposing them to Socratic questioning teaching strategy. The score obtained were male (mean = 19.00, SD = 5.35) and female (mean = 19.00, SD = 4.27) respectively. The value of t-calculated (0.00) was less than the t-critical (2.02) at P < 0.05 and df of 48, indicating that was no significant difference in the achievement of male and female students hence, hypothesis 3 was accepted.

Hypothesis 4

There is no significant difference on the abilities of male and female students when answering questions on the concept of habitat after exposing them to lecture approach.

Table 9: T-test of influence of gender on students' achievement after exposing them to lecture instructional strategy.

Gender	N	X	SD	t-critical	t-calculated
Male	28	13.75	4.45		
				2.02	0.07
Female	18	15.28	4.88		

P < 0.05, df = 44

On testing the hypothesis, table 9 shows an independent sample t-test which was conducted to compare the achievement mean scores of male and female students after exposing them to lecture instructional strategy. The achievement mean and standard scores of male and female students were (mean = 13.75, SD = 4.45) and (mean = 15.28, SD = 4.88) respectively. The computed t-test value was 1.07, which was less than t-critical (2.02), meaning that there was no significant difference between the abilities of male and female students when answering questions on the concept of habitat after exposing them to lecture approach. Therefore, hypothesis 4 was accepted.

Print ISSN: 2057-5238(Print), Online ISSN: 2057-5246(Online)

Hypothesis 5
There is no significant difference between male and female students on their retention abilities on the concept of habitat after exposing them to Socratic questioning teaching strategy.
Table 10: T-test analysis of the influence of gender on students' retention abilities on the concept of habitat after exposing them to Socratic questioning teaching strategy.

Gender	N	X	SD	t-critical	t-calculated
Male	23	18.30	4.99		
				2.02	0.86
Female	27	17.04	5.37		

$P < 0.05$, df = 48
Table 10 reveals an independent sample t-test which was conducted to compare retention abilities of male and female students after exposing them to Socratic teaching strategy. From table 10, the mean and SD scores of male and female students were (mean = 18.30, SD = 4.99) and (mean = 17.04, SD = 5.37) respectively. The t-calculated, (0.86), which was less than t-critical (0.02) at $P < 0.05$ and df of 48, revealed that there was no significant difference between male and female students on retention abilities on the concept of habitat after exposing them to the Socratic question teaching strategy. Hypothesis 5 was therefore, accepted.

Hypothesis 6
There is no significant difference between the male and female students on the retention abilities on the concept of habitat after exposing them to lecture approach.

Table 11: T-test analysis on the influence of gender on students' retention abilities on the concept of habitat after exposing them to lecture instructional strategy.

Gender	N	X	SD	t-critical	t-calculated
Male	28	7.68	2.87		
				2.02	0.33
Female	18	7.94	2.58		

$P < 0.05$, df = 44
Table 11 displays an independent sample t-test conducted to compare the retention abilities of male and female students after exposing them to lecture instructional strategy. The data showed the mean and SD scores for male (male = 7.68, SD = 2.87) and female (mean = 7.94, SD = 2.58) respectively. The computed t-test value was 0.33 and t-critical at $P < 0.05$ with df of 44 was less than the t-critical, it means that there was no significant difference between the male and female students on the retention abilities on the concept of habitat after exposing them to the lecture approach. Hypothesis 6 was therefore, accepted.

DISCUSSION OF FINDINGS

Print ISSN: 2057-5238(Print), Online ISSN: 2057-5246(Online)

Findings from the results of the four research questions are answered and the six hypothesis tested are the bases for the discussion that follows.

Effect of Socratic Questioning and Lecture Instructional Strategies on Students Achievement on the Concept of Habitat.

The result in table 2 and 6 revealed that the students taught using the Socratic questioning teaching strategy had a higher achievement mean score than their counterparts taught using the lecture instructional method. This showed that students taught using Socratic questioning method improved better in achievement than those taught using the lecture strategy. Therefore, this means that Socratic questioning strategy was better than lecture method in improving students' achievement on the concept of habitat. The finding is backed up by the finding in hypothesis I.This finding agrees with the view of Kehinde (2005), who showed that students who are taught using the questioning teaching strategy performed significantly better than those taught using the lecture method approach. Other empirical studies which gave positive effects of questioning teaching strategy in achievement on other science subjects include, Martins and Oyebanji (2000), Ayodele and Agunlaye (2011), Nwosu and Ibe (2003), Esra, Ijlal and Gurbuz (2008), Yaki (2011) and Ali, Hukam- dad, Ahkter and Khan (2010). This was due to the fact that possession of knowledge was not sufficient to make a student solve a problem, but the ability to select and apply appropriate knowledge and skills.

The Effect of Socratic Questioning and Lecture Instructional Strategies on Students' Retention Abilities on the Concept of Habitat

Table 7 shows the mean difference between the two groups (Socratic questioning and lecture method), with Socratic strategy having the mean of 17.32 and lecture method 7.78 respectively. This revealed a difference in the retention abilities of two groups, indicating that the Socratic questioning strategy was better than lecture method in improving students' retention abilities on the concept of habitat, which was the answer to research question 2. The result from hypothesis 2, (see table 7) revealed that there was significant difference between Socratic questioning strategy and lecture method. This indicated that Socratic questioning strategy was superior in improving students' retention abilities than the lecture method. This finding is in agreement with the findings of Aishatau and Danjuma (2005), whose questioning strategy was significantly better than the traditional method in enhancing achievement and retention in physics. It is also in agreement with the findings of Akubuilo (2004) and Jacobson and Obomanu (2011).

The Influence of the Teaching Methods on the Gender of the Students in their Achievement on the Concept of Habitat

This study showed that gender was not influenced by the teaching method in students' achievement on the concept of habitat, whether taught using Socratic questioning method or lecture method approach. Table 8 shows equal performance on male and female students when both were taught the concept of habitat with Socratic questioning strategy (Male: X= 19.00, female: X= 19.00). These revealed that there was no significant difference between the achievements of male and female students (as found in hypothesis 3).

Similarly, table 9 showed that no significant difference existed between male and female students when exposed to lecture method on the concept of habitat, even though the female students had higher achievement mean (15.28) than the male (13.75). The slight increase was not enough to cause a significant difference in achievement between males and female. This result was in agreement with the findings of Adeleye (2007), Afuwape and Oludipe (2008),

Print ISSN: 2057-5238(Print), Online ISSN: 2057-5246(Online)

Udousoro (2011), Abdu-Raheem (2012) and Daniel (2012). However, the result did not agree with those of Adigwe (1999), Inyang and Hannah (2000) and Adeleye (2011), whose work revealed a significant difference in the performance of male and female students in favour of male.

The Influence of the Teaching Methods on the Gender of Students in their Retention Abilities on the Concept of Habitat

The result of hypothesis 5(see table 10) revealed that there was slight difference between means retention abilities of male and female students. It also revealed that gender had no influence on the students' retention abilities on the concept of habitat, with t- calculated value of 0.86 at 0.05 level of significance, which was less than t- critical value of 2.02. Consequently, the hypothesis was accepted indication that no significant difference existed in the retention abilities of male and female students after exposing them to Socratic questioning teaching strategy.Furthermore, in table 11, the data of hypothesis 6 revealed that the t- calculated with respect to the effect of gender on students' retention abilities was 0.33 at 0.05 level of significance when taught the concept of habitat using lecture method. This value was less than t- critical value of 2.02, indicating that no significant difference existed in the retention abilities of male and female students. Consequently, the null hypothesis was accepted.

The finding was in agreement with Alilreza and Sheela (2011), Otili (2012) , Oloyede (2011). Sometimes indiscriminate and unintelligent use of procedures and methods can encourage a poor achievement of objectives. This generally showed that students taught using Socratic questioning strategy performed significantly better in their retention test than those taught using lecture method. But gender had no influence on the students' retention abilities.

The Influence of the Lecture method on the Gender of the Students on their Abilities to Answer Questions on the Concept of Habitat

The result from hypothesis 4 (see table 9) revealed that there was difference between the abilities of male and female student when answering questions on the concept of habitat. However, from the table, the value of t- calculated was 1.07 which was less than the t- critical value of 2.02 at 0.05 level of significance, indicating that no significant difference existed on the abilities of male and female students when answering questions after exposing them to lecture instructional strategy. Therefore, hypothesis 4 was accepted. This agrees with the findings of Olatoye, Aderogba and Aanu (2011) who found that cooperative and individualized teaching method was not significant on the gender of the students. Also, the efficacy of both teaching strategies has nothing to do with the students' gender.

The Influence of the Socratic Questioning Method on the Gender of the Students on their abilities to answer Questions on the Concept of Habitat

The result on table 8 which contains the data for testing hypothesis 3 showed that the value of t- calculated was 0.00 at 0.05 level of significance which was less than t- critical value of 2.02. This means that there was no significant difference in the abilities of male and female students when answering questions on the concept of habitat after exposing them to Socratic questioning strategy. This implies that gender had no effect on the students' abilities. Thus, hypothesis 3 was accepted. The result was in line with the finding of Danjuma (2012) in which the variables used in predicting students abilities to answer questions in science revealed no significant differences between male and female students. However, the result was contrary to the findings of Bilgin, Senocak and Soozbilr (2009) who reported a differential performance on students'

Print ISSN: 2057-5238(Print), Online ISSN: 2057-5246(Online)

abilities with the girls significantly performing better than the boys. Therefore, for any meaningful learning to take place, the student must be able to understand the topic taught, translate the information in different forms, analyze, interpret and apply the strategy in answering questions.

SUMMARY OF THE MAJOR FINDINGS

The effect of Socratic questioning and lecture instructional strategies on students' achievement in biology was investigated. Specially, the investigation was on the effects of the two methods on students' achievement on the concept of habitat as one of the important topics in biology.

A quasi- experimental design was selected for the study. Each of the two groups was also sub-divided into male and female by the researcher as well as their questions- answering abilities and the retention abilities of the students on each of the two groups. A total of 96 senior secondary school II students were selected for the study. Specifically, 50 students were in the Socratic questioning group while, 46 were in lecture method approach group.

In order to give direction to the study, four research questions were answered and six hypotheses were tested. Result revealed that Socratic questioning teaching strategy was significantly better than lecture method in improving students' achievement on the concept of habitat. The achievement as well as their exposure to answer question and retention abilities was not influenced by their gender, whether taught the concept (habitat) using Socratic approach or lecture method approach. Students' abilities to answer questions were not influenced by their gender on the concept of habitat by the teaching methods. This is because equal attention was given to the students regardless of their gender, in both the Socratic questioning and lecture instructional strategies.

CONCLUSION

There is the need to find an alternative method apart from the conventional lecture method commonly used by most schools. The findings and discussion of this study, therefore, revealed that Socratic questioning strategy was significantly better than lecture method in improving students' achievement in biology. The researcher discovered that in Socratic questioning approach, learners are viewed as "intellectual explorers' and 'theory builders", they need unstructured time to develop and test their own ideas as well as the development of their thinking skills. There is always a room for students to answer open- ended questions unlike other methods of teaching.The outcome of the treatment was not influenced by gender. This implies that senior secondary school biology teachers should endeavor to teach with the innovative methods of teaching. This method should be both teacher and student centered.

RECOMMENDATIONS

Based on the findings and the conclusion earlier reported, the following recommendations were made:

i. senior secondary school biology teachers should endeavour to use the Socratic questioning strategy while teaching to improve students' achievement and abilities to answer questions

Print ISSN: 2057-5238(Print), Online ISSN: 2057-5246(Online)

ii. Students should be encouraged to learn some biological concept through the use of appropriate teaching methods.
iii. Teachers should, as much as possible, use activity based methods as instructional strategies, so as to improve cognitive development and the acquisition of skills of subject matter amongst students.
iv. School administrators should encourage their staff on the use of innovation methods of teaching.
v. Biology curriculum should be reconstructed to aid teaching through the questioning method approach.

.

REFERENCES

Abdullahi, A. (1982). *Science teaching in Nigeria*. Ilorin. Atoro Press Ltd.

Acar, F., & Kilic, A. (2011). Secondary-school teachers' questioning activities in learning-teaching process. *Journal of education*, 132(1), 173-184.

Agbo F.O &, Geofrey, J. (2013). An investigation in to teachers' competencies in the teaching of Biology content and practicals in secondary schools in Adamawa state. *International Journal of Research in Science, technology and mathematics education, university of Jos*, 1 (1), 79-88.

Ajayi, M.A (2007). *Effectiveness of practical and theoretical methods on students' performance in physics in Ondo State.* An M.Ed thesis. University of Ado- Eketi, Nigeria.

Alexander, G. P. (2014). The effectiveness of environmental education for sustainable development based on active teaching and learning at high school level; a case study from Puducherry and Cuddalore regions, India. *Journal of sustainable development*, 1 (2), 34-43.

Anderson, L.W., & Krathwohl, D.R. (eds). (2001). *A taxonomy for learning, teaching and assessing: A revision of Blooms taxonomy of educational objectives:* complete edition, New York London.

Arter, J.A., & Chappuis, J. (2006). *Creating & recognizing quality rubrics*. Portland, Oregon: Educational Testing Service.

Atadoga, M. Moses &., Lakpia, A. M. (2013). Effects of problem-solving efficacy and academic achievement in Zaria educational zone, Kaduna state. *International Journal of Research in Science, technology and mathematics education, university of Jos*, 1 (1), 89-99.

Awotunde, P.O Ugodulunwa, & Ozoji, E.D. (1997). *Practical steps to research in education.* Jos: Deka Enterprises, Nigeria.

Awotunde, P.O. Ugodulunwa, C.A (2002). *An introduction to statistical methods in education* . (New edition) Jos: Fab Anieh Nigeria.

Beatrice, A.B. (2013). Relationship between children's learning styles and their academic achievement in science. *International Journal of Research in Science, technology and mathematics education, university of Jos*, 1 (1), 32-39.

Brunner, J.S (1962). *The act of discovery in knowing.* Cambridge: University Press.

Brunner, J.S. (1966). *Toward a theory of instruction*. Cambridge, Z.M.A: Harvard University Press.Capstone Project http:/www.montana.edu/msse/2003%projectsd.htm.Pg.3,4,8,9.

Christiana, F.Z. (2010). *An evaluation of availability and utilization of resources for biology teaching in secondary schools in Plateau state*. Unpublished (M.Ed thesis) university of Jos, Jos.

Print ISSN: 2057-5238(Print), Online ISSN: 2057-5246(Online)

Covey, S. R. (2004). *Seven habits of highly effective people*. New York, NY: Free Press.

Daniel, I. O (2012). Gender different in Nigeria Junior Secondary school students achievement in basic science. *Journal, of Educational and social, research,* 2 (1), 4-7

Danjuma, I.M & Akpan, E.U.E. (2000). Some thought on for tackling problem – solving difficulties in chemistry. *Nigerian journal of Curriculum studies*, 7 (1&2), 129-135.

Dantonio, M. & Beisenherz, P. C. (2001). *Learning to Question, Questioning to Learn.* Boston : Allyn and Bacon

Deshi, J. M. (2011). *Effects of guided discovery method on SSSIII students' academic achievement in Biology (Genetics) in Pankshin Town of Plateau state*. Unpublished (M.Ed thesis) University of Jos, Jos.

Eistner, W. Elliot (2000). Benjamin bloom: UNESCO: international bureau of education.http:///www.ibe.unesco.org//international/publication/thinkers/bloomepaf.p.1

Esra, O. Ijlal, & Gurbuz, O. (2009). *Sequential teaching methods in biology and their effects in academic achievement.* Kuramsal Egitimbilim, 2(2), 23-43.

Federal Government of Nigeria (2005). National Policy on Education. Abuja. NERDC

Federal Republic of Nigeria (1998). National Policy on education. 3rd Edition. Lagos: NERDC press p9.

Garba, R.B. (2004). Teachers' classroom control and students academic achievement. Unpublished. Master thesis. University of Jos.

Gushi, I. (2013). The effects of programmed instruction on achievement of students in trigonometry in Mangu LGA of Plateau state, University of Jos (Unpublished)

Inyany, N.U & Hannah, E. (2000). Influence of ability and gender grouping on senior secondary school chemistry students ' achievement on the concept of radix reactions. *Journal of science teacher Association of Nigeria*, 35 (1&1), 36-42.

J.D. Walker, D. Christopher Brooks & Paul Baepler (11th December, 2011). Pedagogy and space: Empirical research on new learning Environments. Retrieved from www.er.educause.edu/articles/2011/2012/pedagogy-and-space-empirical-research-on-new-learning-environment.

Jegede, O.J. (1996). *Fostering students understanding of science concepts.* A paper presentation in a workshop at the Science Teachers Association of Nigeria (STAN) Uyo, Akwa Ibom State, at the 37th Annual conference on 12-17 August 1996.

Khan, W., & Inamullah, H. (2011). A study of lower-order and higher-order questions at secondary level. *Asian Social Science, 7*(9), 149-157. doi:10.5539/ass.v7n9p149

Labeeb, A. J. (August, 2010). Comparative study of effectiveness of programmed instruction and lecture demonstration methods on the performance of chemistry students in senior secondary school in two local government areas, Osun state.

Mankilik, M. &., Macmilian, M. J. (2013). Effects of computer-assisted instruction on students' achievement in secondary school physics in Pankshin local government Area of plateau state. *International Journal of Research in Science, technology and mathematics education, university of Jos*, 1 (1); 23-31.

Martins, O.O. & Oyebanji, P,K (2000). The effect of inquiry and lecture method on the cognitive achievement of integrated science students. *Journal of Science Teachers Association of Nigeria*, 35 (1&2), 31-75.

Menyu, P. G. (2003). *Students' participation, attitude and performance in biology practicals in some senior secondary schools of Adamawa state.* Unpublished (M.Ed thesis) university of Jos, Jos.

Print ISSN: 2057-5238(Print), Online ISSN: 2057-5246(Online)

Mohammed, H. (2011). *Effects of outdoor biology laboratory on students' performance in Biology in senior secondary schools in Bauchi state.* Unpublished (M.Ed thesis) university of Jos, Jos.

Musa, A. (October, 2013). *Effects of cooperative learning strategy on Physics' students attitudes and performance in secondary schools in central zone, plateau state*. Unpublished (M.Ed thesis) university of Jos, Jos.

Nwosu, A.A., & Ibe, E. (2013). Effects of guided- inquiry and demonstration on science process skills acquisition among secondary schools Biology Study. *Journal of Science Teachers Association of Nigeria*, 38(1&2), 56-59.

Nwosu, A.A., & Okeke, E.A.C. (1995). The effects of teachers sensitization of students' acquisition of science process skills. *Journal of the science teachers' association of Nigeria,* 30 (1&2), 39-45.

Obande, C. I. (2016). *The development and effects of ecological standards on students' knowledge, skills and attitudes acquisition.* Unpublished (M.Ed thesis) university of Jos, Jos.

Obiekwe, E. (2009). Effects of constructivist instructional approach on students' achievement and interest in basic ecological concepts in biology. Unpublished (M.ED thesis), Department of science education, University of Nigeria, Nsukka.

Ogunniyi, M.B (1986b). *Teaching science in Africa Salam media Nig. Ltd.*

Ogunniyi, M.B. (1986). *Under- achievement in science and the emerging anti- science culture in Nigeria*. A paper presentation in a workshop at the Science Teachers Association of Nigeria (STAN) Owerri, of her 27th annual conference on 25th-30th August, 1986.

Ogunniyi, M.B. (2008). T*eaching and learning primary science and method*. Ibadan: Heinem Educational books. (Nigeria) Plc.

Okebukola, P. (2002). *Beyond the stereotype to new trajectories in science teaching.* Science teachers association in Nigeria pp. 20,21.

Onwukwe, R.N (2004). *Advanced Psychology of Learning and scientific enquires.* Enugu, Nigeria: John Jacob's Classic Publishers.

Patrick, N. B. (2010). The influence of teachers' motivation on students' achievement in mathematic in secondary schools of Godogodo inspectorate division, Kaduna state; University of Jos. (unpublished).

Posner, G.J., Strike, K.A, Hewson, P.W., Jrving S. &., Gertzog, W.A (1998). Accommodation of scientific conception. *Science education,* 66,21-227.

Ramlingam (2001). *Modern biology for secondary school.* new edition, revised African first publishes limited pp, 101-115, 335-344.

Rose, S. &., Litcher, J. (1998). Effective questioning techniques: in theory and Practice. In *Studies in Teaching,* ed. Leah P. McCoy. Winston Salem, NC: Wake Forest University.

Sambo, A. (2005). *Research Method in education.* Ibadan, Nigeria: Sterling- Horden Publishers Nigeria Limited.

Science Teachers Association of Nigeria (2008). Science teachers handbook. Ibadan; Longman Nigeria ltd.

Shaibu, A.A.M & Mari, J.S. (2000). Gender-r elated difference in understanding of science process kills amongst junior secondary schools. *Journal of science teachers association of Nigeria,* 32 (1&2), 21-27.

Shaunessy, E. (2000). Questioning techniques in the gifted classroom. *Gifted Child Today*, *23*(5), 14.

Sidi, D. (2009). The effect of constructivist teachers' strategy on students' attitude and

Print ISSN: 2057-5238(Print), Online ISSN: 2057-5246(Online)

achievement in Photosynthesis. *Journal of biological development science,* 2 (4), 12-21.
The New Encyclopedia Britannica (1989). Concept Formation.Vol.3.15th edition, author p.514.
The New Webster's Dictionary of the English Language (1995) International Edition. New York: Lexicon International Publisher Guide Group.
Tienken, C. H., Goldberg, S., & DiRocco, D. (2010). Questioning the questions. *Education Digest, 75*(9), 28-32.

Tongyola Sati (April, 2014). The influence of SMASE on teaching and learning of mathematics in primary schools in Plateau state; University of Jos (unpublished)
Ugodulunwa, A.C & Ugwanyi, L.C (2003). Understanding educational evaluation, revised second edition, Jos: Fab Anieh (Nig) Ltd.
Ugodulunwa, C.A (2008). Foundation of education measurement and evaluation. Jos. Fab Educational books.
Umoru, & Adejjoh (2013). Effects of advanced organizers on students' achievement in Biology in secondary schools in Makurdi local government Area. *International Journal of Research in Science, technology and mathematics education, university of Jos,* 1 (1), 1-9.
Uzolgwe, P. N. (2008). *The effects of small group peer tutoring learning, on achievement and retention of SSII students, on physics concepts in Northern zone of Plateau state.* Unpublished *(*M.Ed thesis) university of Jos, Jos.
Vogler, K. E. (2005). Improve Your Verbal Questioning. *Clearing House*, 79(2), 98-103.
Wakjissa, S. S. (2016). *Effects of attitude on their' portfolio assessment scores in secondary school Geography*. A paper presentation at the international conference of the Plateau state secondary school, Jos, Plateau State.
Walsh, J. & Sattes, B. (2011) Thinking through quality questioning: Deepening student engagement. Thousand Oaks, CA: Corwin Press.
Walsh, J. (2010). *How Can Quality Questioning Transform Classrooms?* Retrieved April 11, 2012, from http://www.sagepub.com/upmdata/6605_walsh_ch_1.pdf
Wolf, D. (1997,Winter). The art of questioning. *Academic Connections* 1-7. Retrieved July 23, 2000 from the World Wide Web: http://www.exploratorium.com/IFI/resources/workshops/artofquestioning.html
www.mhhe.com/socience/intro/cafe/lahe7/stduent/olc.chap08glorrsary.hhtml.
Yaki, A.A. (2011). Effects of guided inquiry instructional strategy in cooperative and industrial learning setting on secondary schools students achievement in biology in Abuja Municipal area council. *Journal of Science, Technology, Education,* 7 (3), 204-2012.
Yoloye, T.W. (2004). *Increasing female participation in science.* Mimeograph: University of Ibadan, Nigeria.
Young, A. J. (1997). I think, therefore I'm motivated: The relations among cognitive strategy use, motivational orientation and classroom perceptions over time. *Learning and individual differences*, *9*(3), 249-283.
Yusuf, M.A. & Adigun, J.T. (2010). The influence of school sex, location and type on students academic performance. *International journal of education science,* 2(2), 81-85.

Print ISSN: 2057-5238(Print), Online ISSN: 2057-5246(Online)