

THE INTERNATIONAL JOURNAL OF HUMANITIES & SOCIAL STUDIES

Effect of Socratic Teaching Technique on Performance in Evolution Concept among NCE II Biology Students of College of Education Gashua, Yobe State, Nigeria

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Abstract

The study investigated the effect of Socratic Teaching Strategy on the academic performance on evolution concept in biology among NCE II students of College of Education Gashua, Yobe State. Pre-test Post-test Quasi-Experimental and control groups design was used for this study. The study used a population of 150 students (99 boys and 51 girls), which also served as the sample for the study. The research instrument used for data collection; Evolution Concept Achievement Test (ECAT) was tested for reliability using Kuder-Richardson (KR21) with reliability coefficient of 0.87. T-test statistic was used to identify the difference between the performance of students exposed to Socratic Teaching Strategy and those taught using the traditional method. The result of the study revealed significant difference between the mean academic performance scores of the experimental and control groups in favour of experimental group. It is therefore recommended that; i) teachers should be encouraged to adopt Socratic Teaching Strategy for effective teaching and learning. ii) Stakeholders in education like; NCCE, STAN, NERDC and NGOs to organize workshops to train teachers for the effective implementation on the use of Socratic Method.

Keywords: Socratic technique, performance, NCE II biology students

1. Introduction

Biology as a science subject requires all students studying the course to develop some basic scientific skills such as the ability to observe and investigate (finding out) which involves systematic collection, analysis, organization and interpreting data. The students' active participation in these processes and their interaction with instructional materials would serve as effective means of arousing students' interest towards learning, thus enhancing performance among biology students (Hollandsworth, 1999). The biology curriculum for colleges of education is designed to produce knowledgeable, highly motivated, professional and effective teachers of biology who will be able to develop in students an appreciation and understanding of biological processes and principles. The NCE programme is also designed to develop confidence in the biology teacher and enhance his ability to adapt to the changing situations in science and technologically oriented society (NCCE, Minimum Standard, 2012). Biology teaching at NCE level aims to produce teachers who will be able to; view biology as a process of inquiry into the living world, critically analyse the activities of living things in their environment, demonstrate practical skills in handling scientific skills, demonstrate excellence and professional competence in teaching biology, inculcate positive scientific attitudes and values requisite for development of the society.

The idea of 'paradigm shift in post-graduate studies for service and development' is quite in tune with the biology curriculum for colleges of education which also called for a shift in methodology, from teacher-centred to learner-centred. Berret (2012) believes that science education should be dynamic and not be about information dissemination which students lose shortly after writing examinations. Rather, science should engage students to explain concepts through effective interaction, and Socratic Method is an excellent technique for achieving that. The essential message delivered at a teaching and learning conference at Harvard (2012) suggested the use of Socratic teaching technique as a fundamental component of the transition away from traditional science teaching practice to learner-centred practice. It is against this background that the researcher intends to use Socratic Teaching Strategy to teach evolution concept in biology to probably solve the problem of poor performance. This is because, not many works have been found to utilize this method at NCE level.

The National Policy on Education describes the objectives of biology curriculum as fostering adequate laboratory and field skills in biology, relevant and meaningful knowledge, ability to apply scientific knowledge to everyday life on matters personal and community health and agriculture, as well as reasonable and functional scientific attitude (FME, 2013). The aspect of curriculum development in biology at NCE level, like with other levels has focused more on mechanical delivery or through rote learning over the years, making instruction teacher-centred. Abstract concepts in biology such as evolution and genetics, among others can hardly be effectively taught to students theoretically at NCE level, just like with secondary schools (Usman, Olorukooba & Muonomi, 2014). One of the major causes of poor academic performance by students in biology may be attributed to the types of teaching methods adopted by teachers, because most

of the teachers still prefer to use the popular lecture method. However, the problem of ineffective teaching of abstract concepts which consequently leads to poor academic performance of students can be effectively overcome by using teaching methods which are learner-centred. A variety of methods have been advocated for teaching biology at various levels of education including NCE, ranging from lecture, inquiry, laboratory, demonstration, discussion among others (Obeka, 2010). But despite these, there is still poor performance when it comes to abstract concepts such as evolution at NCE level. The research work of Usman, Olorukooba & Muonemi (2014) also saw the need to reconsider the techniques and methods of instruction at various levels of education to address the challenges of biology education. They believe that to address these challenges, there should be in place an instructional system or approach which is learner-centred, that will motivate and encourage students to understand abstract concepts like meiosis, evolution, among others.

Learner-centred method contributes in the motivation of students, encouraging them to take active part in the learning process, helping them to develop creativity, problem-solving skills among others. Socratic strategy as a teaching method is an approach which is learner-centred and challenges learners to develop their critical thinking skills and engage in analytic interaction. The Socratic strategy can be used at any grade or class and with all subject areas and lessons, and can be adapted to fit a changing situation or society. This strategy comes into being based on the belief that lecture method was not an effective method of teaching all categories of students. Socrates believed that through this method, students could improve their reasoning skills and ultimately move towards more rational thinking and ideas more easily supported by logic.

Education under Socratic Teaching Strategy encourages teachers to engage students by asking questions that require generative answers; and ideally, the answers to such questions are not a stepping point for thought but a beginning to further analysis and research. However, teachers can use the Socratic Teaching Strategy in different subject areas, including biology and across grade levels in order to challenge students to examine both current and historical issues (Copeland, 2016). The essence of Socratic strategy is to help students to process information and engage in deeper understanding of instructional topics. Most importantly, Socratic teaching strategy engages students in dialogue and undertakes interaction that is collaborative and open-minded as opposed to debate, which is often competitive and individualized. The role of teachers under Socratic strategy is to develop open-minded questions about texts and encourage students to use textual evidence to support their opinions and answers. In this manner, teachers use questions to guide students' interaction around specific learning goals and objectives. It is also important for teachers to establish guidelines to help students understand their roles and responsibilities in the Socratic teaching process.

The active involvement of learners in the process of learning develops their interest towards learning, thus improves performance

2. Theoretical Framework

This study was based on the constructivists' theory (Piaget, 1947; Ausubel, 1978) which is one of the theories of learning science. This theory emphasizes active participation of learner(s) in the process of finding out information through organizing and reconstructing knowledge. Learning according to constructivism, places more emphasis on the student (learner) rather than the teacher. Teachers are seen as facilitators or coaches who assist students to construct their conceptualizations and find solutions to problems. The learner interacts with objects and events, and thereby gains an understanding of the features held by such objects or events (Ausubel, Novak, & Hanesian, 1978; Hund & Teagust, 1989; Bichi, 2006).

Socratic Teaching Strategy also advocates the principle of learner-centred form of learning where the learner actively participates in the process of learning by interacting with the instructional materials and with colleagues, while the teacher serves as a guide or moderator (Bonet, 2007; Atadoga & Onalapo, 2008; Copeland, 2016). This research was therefore based on the framework of 'constructivism'. The students will have the opportunity to interact with the instructional content by way of articulating the points and possible questions for the discussion and also interact among themselves and with the teacher during the discussion. The teacher also serves as the moderator and guide throughout the discussion process. This motivates the students to develop interest in the overall learning process, thus improving their performance in test and examination.

The main purpose of this study therefore, was proposed to investigate the effect of Socratic Teaching Strategy on academic performance among NCE II biology students of College of Education Gashua, Yobe State, Nigeria.

3. Null Hypotheses

The following null hypothesis was formulated for testing at $P \leq 0.05$ level of significance:

- Ho: there is no significant difference between the academic performance of students exposed to Socratic Teaching Strategy and those taught using Lecture.

4. Methodology

The research is a pretest-posttest Quasi-Experimental and Control groups design (Kerlinger, 1973), in which subjects were randomly assigned into experimental and control groups. This is in order to determine any possible treatment effect. This study comprised of two (2) groups, experimental (E) and control (C) groups. Experimental group (E) received treatment involving Socratic Teaching Strategy only and Control group (C) were taught using Lecture method only.

The pre-test is to find out the equivalence of the two (2) groups in their academic performance while the post-test determined their academic performance after exposure to treatment. The design layout is illustrated in Figure 1.



Figure 1: Research Design Illustration (Experimental/Control Group Design)

Where:

E = Experimental Group

C = Control Group

O₁ = Pretest

O₂ = Posttest

X₀ = Lecture Method

X₁ = Treatment Group (Socratic Strategy)

5. Population for the Study

The target population for the study comprised NCE II Evolution students of College of Education, Gashua (2014/2015 and 2015/2016 sessions).

S/N	Academic Level/Session	Boys	Girls	Total
1	NCE II, 2014/2015	48	27	75
2	NCE II, 2015/2016	51	24	75
	Grand Total	99	51	150

Table 1: Population of the Study
Source: Biology Department Evolution Course Lists, 2014/2015 and 2015/2016

6. Sample and Sampling Technique

Since only students from two (2) sessions served as the study population, and in order to ensure relative similarities in the variables of interest such as gender, the students of the two (2) sessions were randomly categorized into Experimental and Control Groups through simple balloting. A total of 150 students (99 boys and 51 girls) served as sample for the study. The number is viable for the study based on central limit theory (Tuckman, 1975) recommendation, that 30 study sample is viable for experimental study (Turckman, 1975; Fraenkel & Wallen, 2000; Sambo, 2008). Evolution Concept Achievement Test (ECAT) was used for data collection.

The reliability of the instrument was determined through test-retest method and analysed using Kuder-Richardson (K-R) 21 reliability coefficient (Ogodulunwa and Ugwanyi, 1999; Ogunleye, 2000). A reliability value of 0.87 was obtained, thus the instrument was adjudged to be reliable. The instrument (ECAT) was validated by Principal Lecturers with a minimum of 10 years working experience in College of Education, covering both content and face validity.

S/N	Academic Level/Session	Boys	Girls	Total
1	NCE II, 2014/2015	48	27	75
2	NCE II, 2015/2016	51	24	75
	Grand Total	99	51	150

Table 2: Sample for the Study
Source: Biology Department Evolution Course Lists, 2014/2015 and 2015/2016

6.1. Experimental Group

The administration of treatment was done by the researcher himself, so as to remove any form of biasness. The main treatment involved teaching using Socratic Teaching Strategy. The presentation was in line with the model adapted from Socrates (1983; 2000), Weimer (2016), and Copeland (2016) which has four (4) stages of activities:

- Stage I: The lesson package (lesson note) on the topic of discussion was provided by the researcher to each student to study and also come up with question(s) related to the instructional contents.
- Stage II: The questions were vetted by the researcher in preparation for the discussion process. The questions determine the course of the discussion.
- Stage III: Presentation of the lesson involves clarifying the aims of the lesson by the researcher to the students on how each student is expected to ask or answer question(s) or make contribution(s).

- Stage IV: The researcher summarizes the main points of the discussion process, giving room for observations/contributions from the students.

6.2. The Control Group

The control group (C) were exposed to the same instructional contents using lecture method. The researcher himself delivered the instructional contents to the students using lecture method. After the lecture period (which lasted for six (6) weeks), ECAT was given to the control (C) group as post- test. The post-test was to determine the effect of the lecture on academic performance. The scores obtained were used and tested the hypothesis formulated in chapter one.

6.3. Results

The post-test means scores for both experimental and control groups were obtained and analysed using two sample t-test statistic. This was to determine the academic performance of the two (2) groups (experimental and control groups). The null hypothesis of this research study was decided at the significant level of $P \leq 0.05$.

6.4. Hull Hypothesis

There is no significant difference in academic performance between biology students taught evolution concept using Socratic Teaching Strategy and those taught using Lecture Method.

In order to test for the significant difference between the experimental and control groups after the treatment, t-test scores were used to determine the significance between the two variables. The result of the t-test is presented in Tables 3.3below:

Variables Group	N	X	SD	t-Cal	t-Crit	DF	P	Remark
Pretest Experimental								
	75	6.82	5.061	36.906	1.98	148	0.001	Significant
Control	75	5.71	4.321					
Posttest								
	N	X	SD	t-Cal	t-Crit	DF	P	Remark
Experimental	75	10.77	7.011	51.316	1.98	148	0.001	Significant
Control	75	5.86	4.441					

Table 3: Two Sample T-Test Analysis on Mean Performance Scores of Experimental and Control Groups

The result of the analysis in Table 3 showed that the experimental group taught using Socratic Teaching Technique performed higher than the control group taught using lecture method. This is indicated by the T-calculated score of 6.82 for pre-test and 10.77 for post-test after exposure to treatment. The observed level of significance for both pre-test and post-test were lower than the fixed level of 0.05 (>0.05). This significant difference in performance in favour of the experimental group suggested a greater effectiveness of Socratic strategy over the lecture method. Therefore, the null hypothesis that there is no significant difference between the performance of experimental group exposed to Socratic Teaching Strategy and the performance of control group exposed to Lecture Method is rejected.

7. Discussion

The study investigated the effect of Socratic Teaching Strategy on academic performance in Evolution Concept among NCE II students of College of Education, Gashua. The findings from the hypothesis revealed that the students in the experimental group exposed to Socratic Strategy performed significantly higher than the control group taught the same concept using lecture method. The finding here is consistent with (Christopher,2014) which reported that students' achievement using Socratic Method showed higher grades statistically in Bio 111 and Bio 112 when compared to students taught the same courses using the traditional lecture method. Similarly, Birschbacher (1999) & York(2010) both reported that Socratic method challenge students to debate and defend positions, while the teacher guides and asks questions during the instruction, and this enhances academic performance over the traditional method.

8. Conclusion

In conclusion, the findings of this study showed that the academic achievement of students in evolution concept of biology can be enhanced by the use of Socratic Teaching Strategy. This was explained by the significant difference in performance between the students taught using Socratic Method (Experimental group) and those taught using the traditional lecture method (Control group).

9. Recommendations

Teachers in Colleges of Education and indeed other tertiary institutions should be encouraged through seminars and workshops to adopt this innovative technique of teaching (the Socratic Method) as alternative to the traditional teacher-centred method (the Lecture Method).

Stakeholders in education such as; Ministries of Education, National Education Research and Development council (NERDC), National Commission for Colleges of Education (NCCE), Parents-Teachers Associations (PTAs), Non-Governmental Organizations (NGOs) should be encouraged to provide adequate financial and material support for effective teaching and learning of evolution concept in biology at Colleges of Education, using Socratic Method.

Heads of Biology Departments of Colleges of Education should encourage or promote the use of Socratic Method due to its effectiveness in teaching and learning.

Professional bodies like Science Teachers Association of Nigeria (STAN), National Education Research and Development council (NERDC) should incorporate Socratic Instructional package in their science curriculum to encourage the use of the method by teachers.

Workshops should be organized by NCCE, NERDC, STAN, NGOs and all stakeholders of education in order to train teachers for effective implementation on the use of Socratic Method

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