EFFECTS OF STRUCTURED-INQUIRY TEACHING METHOD ON SECONDARY SCHOOL STUDENTS' ACADEMIC PERFORMANCE IN BASIC SCIENCE FOR ATTAINING SUSTAINABLE GOALS IN DISORIENTED SOCIETY

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ABSTRACT
Knowledge in Basic Science is central and indispensable to the development of every nation. The study investigated the effects of structured-inquiry teaching method on students' academic performance in Basic science in Public Secondary Schools in Ekiti State, Nigeria. The research design adopted in the study was a Pretest-Posttest Quasi-experimental. The sample for the study comprised 140 Junior Secondary School two (JSS2) Basic Science students selected through the multistage sampling technique from a total population of 7,014 JSS2 Basic Science students in all the 184 Public Secondary Schools in Ekiti State. The instrument used to collect relevant data from the subjects was Basic Science Performance Test (BSPT). The reliability of the instrument was determined through the split-half method with the reliability coefficient of 0.91. Two null hypotheses were tested at 0.05 level of significance.The data collected were analyzed using t-test statistical analysis. The results of the analysis showed that there was a significant difference in the academic performance of students in Basic Science in the experimental and control groups in favour of the experimental group. Based on the findings of the study, it was concluded that structured-inquiry teaching method is more effective in improving students' performance in Basic Science in Secondary Schools than the conventional method which is still widely in use and it was recommended that the conventional method presently in use by Basic Science teachers should either be improved on, modified or replaced with an activity-based teaching approach (as may be appropriate).
KEYWORDS: *structured-inquiry, teaching methods, sustainable goals, disoriented society, academic performance*

INTRODUCTION

Science is an organized body of knowledge in form of concepts, laws, theories and generalizations. Urevbu (2001) defined science as "a study of nature and natural phenomena in order to discover their principles and laws". It is also regarded as knowledge or a system covering general truths or the operation of general laws especially as obtained and tested through scientific method.

Science education is a field of study concerned with producing a scientifically literate society. It acquaints students with certain basic knowledge, skills and attitudes

needed for future work in science and science-related fields (Omorogbe and Ewansiha, 2013). Science education is a distinct form at creative human activity which involves ways of seeing, exploring and understanding reality. Science being a fundamental part of everyday life and essential for understanding of the world teaches us a way to find out about the world and this helps us to develop a growing body of ideas and work.

Basic Science as a subject in Nigeria introduces pupils and students under the basic education programme in the lower and upper basic level to the basic rudiments of science. The National Policy on Education defined the subject as the aspect of education which leads to acquisition of practical and applied basic scientific knowledge. The main reason for teaching basic science is to widen the knowledge of students which enables them to appreciate the unity among science subjects (Nwafor, 2015). Appreciating the unity among the science subjects could influence their choice of science oriented career which could in the course enhance scientific development in the nation (Danjuma, 2019). Knowledge in Basic science is central and indispensable to the development of every nation.

Different methods and strategies have been adopted to assist students in the process of learning and understanding basic science. The shortcomings of traditional methods of teaching resulted in the persistent search for an effective method of teaching and learning basic science. This led to the discovery and suggestions by some researchers for the use of innovative teaching methods such as inquiry method, concept mapping, simulations and games, problem-based learning and so on (Guzel, 2004). In the innovative teaching methods, the teacher is often described as a partner and a facilitator in the teaching and learning process and not the possessor of knowledge. Hence, the innovative teaching methods are referred to as student-centered approach to learning. Owolabi and Oginni (2013) identified that good teaching method is the result of exposing students to certain experience through adequate guidance and providing learning activities so that students can acquire the best from learning.

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs (Chartterjee, 2015). Sustainable development aims to address all the environmental, economic and social-political problems, without compromising either one another and without jeopardizing human capability and development. The Sustainable Development Goals (SDGs) are a collection of 17 global goals set by the United Nations General Assembly in 2015 for year 2030. The SDGs are part of resolution 70/1 of the United Nations General Assembly, the 2030 Agenda.

The Sustainable Development Goals are:

1. No Poverty

2. Zero Hunger

3. Good Health and Well being

4. Quality Education

5. Gender Equality

6. Clean Water and Sanitation

7. Affordable and Clean water

8. Decent Work and Economic Growth

9. Industry, Innovation, and Infrastructure

10. Reducing Inequality

11. Sustainable Cities and Communities

12. Responsible Consumption and Production

13. Climate Action

14. Life Below water

15. Life on land

16. Peace, Justice, and Strong Institutions

17. Partnerships for the Goals

Disoriented society is presented with an unfamiliar experience or idea which involves new ideas that challenge the society to think critically about their beliefs and values. The society reacts by becoming confused and anxious. Support from the educator at this point is crucial to the society's motivation, participation and self-esteem (Harold, 2007). Working and learning in our information-rich environments with constantly changing tools and business rules presents us with frequent periods of disorientation. As learning specialists, one of our roles should be to help people/society with their disorientation and exploration.

Academic performance is the extent to which a student, teacher or institution has achieved their short or long-term educational goals, Cumulative Gross Point Average (CGPA) and completion of educational benchmarks such as secondary school diplomas and bachelor's degrees represent academic achievement (Wikipedia, 2019).

In this study, structured-inquiry based teaching/learning method is considered. This is because the strategy helps to develop students' thinking and decision making abilities which are vital to attaining sustainable goals in a disoriented society.

Inquiry is a term used in science teaching that refers to a way of questioning, seeking knowledge, information or finding out about phenomena. This is a new trend in teaching process founded by Dewey's reform of educational system, where he advocated child-centered learning based on real-world. Inquiry requires identifying assumptions use of critical and logical thinking and consideration of alternative explanations. (National Research Council, 2000).Rust (2011) defined inquiry as an outcome of science teaching characterized by knowledge and understanding of the processes and methods of science. On the other hand, Educational Broadcasting Corporation (2004) simply defined inquiry as "seeking for truth, information or knowledge by questioning".

Structured-inquiry method is concerned with the teacher providing the students with initial research questions and an outline of procedure to follow to solve the research questions. The teacher sets parameters and procedures for inquiry. Colburn (2000) asserted that in structured inquiry, students are provided with hands-on problems to investigate as well as the procedures and materials necessary to complete the investigation but not the expected outcome. According to Golden, Tuttle and Weirich (2010), the value in using structured-inquiry allows the teacher to teach students the basic of investigating as well as techniques of using various equipments and procedures that can be used in more complicated investigations. In other words, structured-inquiry provides students with common learning experiences that can be used in guided or open inquiry (Colburn, 2000).

In structured-inquiry, the learning is to introduce students to the experience of practicing a specific skill such as collecting and analyzing data. The hypotheses and procedure are still provided by the teaching, however, students generate an explanation supported by the evidence they have collected (Liewellyn, 2005). The teacher has a greater degree of control by supporting and directing the students during the phases of inquiry. These phases are: question/hypotheses, operationalization, and partly on data collection. The students then need to perform the rst of the phases, data collection, interpretation and communication. However, in the structured-inquiry, teacher's guidance can be spread in most of the other phases by assisting students in certain sub-tasks. For example, students will perform the data analysis but the teacher might explain to them the appropriate method and tools (Buntern, Lee, Srikoon, Vangpoomyai, Rattanavongsa and Rachahoon, 2014).

Schmid (2015) also studied whether structured-inquiry based science education provided the theoretical based for 9th grader lesson, labeled "the hearing of sound". Finding from the study revealed that the students gained a significant short-term and a long-term increase in knowledge scores after six weeks. Furthermore, students showed a constant

level of content knowledge when tested after 12 weeks, indicating that students did not forgot information within the last six weeks. The study also revealed that the structured-inquiry lesson was suitable for both genders, as well as students with both high and low pre-knowledge.

The role of teachers in a structured-inquiry classroom setting is of paramount importance if the method is to be successfully carried out. Golden, Tuttle and Weirich (2016) revealed that the teacher is expected to perform the following roles:

- Provides specific steps for students to follow
- Provides materials and supplies for the activities
- Encourages students to work as a group
- Occasionally asks probing type of questions to check for understanding
- Answers questions that do not need to be researched; and
- Monitor the classroom to ensure all students are participating.

Through structured-inquiry method of teaching, our disoriented society can attain SGs in the following ways

- End poverty in all its forms everywhere
- End hunger, achieve food security and improved nutrition and promote sustainable agriculture
- Ensure healthy lives and promote well-being for all at all ages
- Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
- Achieve gender equality and empower all women and girls
- Ensure availability and sustainable management of water and sanitation for all
- Ensure access to affordable, reliable, sustainable and modern energy for all
- Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
- Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
- Reduce inequality within and among countries
- Make cities and human settlements inclusive, safe, resilient and sustainable
- Ensure sustainable consumption and production patterns
- Take urgent action to combat climate change and its impacts
- Conserve and sustainably use the oceans, seas and marine resources for sustainable development

- Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
- Promote peaceful and inclusive societies for sustainable development, provides access to justice for all and build effective, accountable and inclusive institutions at all levels
- Strengthen the means of implementation and revitalize the global partnership for sustainable development.

Gender inequality in education has remained a perennial problem of global scope (UNESCO, 2004). The learning of basic science in schools could be influenced by students' gender. The disparity in the performance of males and females in the sciences is been studied every day. Some of the studies show that girls perform poorly when compared to boys at all levels of science education in Nigeria (Danjuma, 2019). Nwagbo and Obiekwe (2010) observed that the achievement and the result of learning efficiency of male and female students may be different because some schools either by omission or commission provide a platform for channeling children into prescribed gender activities. In another study carried out by Busola (2011), boys were found to perform better than girls in science. Danjuma (2015) submitted that gender gap that existed between male and female students in basic science is reducing.

PURPOSE OF THE STUDY

The study was intended to investigate the effects of structured-inquiry teaching method on students' learning outcome in basic science for attaining Sustainable Goals in Disoriented Society. The specific objectives of the study were to:

i. Highlight the needs for basic science teachers in using relevant and appropriate teaching method(s) in secondary schools

ii. Provide information on structured-inquiry teaching method on the influence of gender difference on their level of performance in basic science in secondary schools.

RESEARCH QUESTIONS

The following research questions were raised to guide the study:

1. Will there be any difference in the academic performance of students taught basic science using structured-inquiry and conventional methods?

2. What is the influence of gender on the mean performance scores of students taught using structured-inquiry and conventional methods?

RESEARCH HYPOTHESES

The following null hypotheses were formulated and tested at 0.05 level of significance:

1. There is no significant difference in the performance mean scores of students taught using structured-inquiry teaching method and conventional teaching methods after the treatment.

2. There is no significant difference in the performance mean scores of male and female students taught in each of structured-inquiry teaching method and conventional teaching methods.

RESEARCH DESIGN AND PROCEDURE

The research design adopted in the study was a pretest, posttest, control group quasi-experimental. Purposive and stratified random sampling techniques was used to select a total sample of 140 students comprising 70 male and 70 female students that were randomly assigned to experimental and control groups using simple random sampling procedure. The experimental group consist of 31 male and 39 female students while the control group consist of 35 male and 35 female students.

The treatment package used for the study was tagged: Structured-Inquiry Method Instructional Package (SIMIP). The instrument used to collect relevant data from the subjects was Basic Science Performance Test (BSPT). The reliability of the instrument was determined through the split-half method with the reliability coefficient of 0.91.

The administration of the instrument was in three stages: the pre-treatment stage (two weeks), the treatment stage (four weeks) and the post-treatment stage (two weeks). Experimental group was taught basic science using structured-inquiry while the control group was taught basic science using the conventional method.

Two null hypotheses were tested at 0.05 level of significance. The data collected were analyzed using mean, standard deviation and t-test statistical package.

RESULTS

Hypothesis 1

There is no significant difference in the performance mean scores of students taught using structured-inquiry teaching method and conventional teaching methods after the treatment.

Table 1: Analysis of the Post-test Mean Scores of the Experimental and Control

Variable	N	df	$\bar{X}$	SD	t_{cal}	t_{tab}
Experimental Group	70		20.25	0.12	5.6012*	3.357
Control Group	70	138	15.34	0.10		

* = Significant at P < 0.05

Table 1 shows mean and standard deviation of the performance scores for experimental and control groups as 20.25 and standard deviation 5.97 and 15.34 and standard deviation 4.26 respectively. The table revealed that the performance of experimental and control groups differ significantly as t_{cal} = 5.6012 with df = 138 at t_{tab} = 3.357 which is less than 0.05 significant level set for the hypothesis, hence the hypothesis was rejected.

Hypothesis 2

There is no significant difference in the performance mean scores of male and female students taught in each of structured-inquiry teaching method and conventional teaching methods.

Table 2: Analysis of the mean performance scores of Male and Female students taught basic science using structured-inquiry teaching method

Variable	N	df	$\bar{X}$	SD	t_{cal}	t_{tab}
Male	31		20.12	6.21	0.8887^{NS}	3.435
Female	39	68	18.89	5.12		

NS = Not Significant at P > 0.05

Table 2 shows the mean and standard deviation of post-test scores of male and female students are 20.12 and Standard Deviation 6.21 and 18.89 and standard deviation 5.12 respectively. Therefore, the difference in the mean performance test score of the male students taught using structured-inquiry is insignificant to that of the female students taught with same structured-inquiry, the table revealed that the male students' performance did not differ significantly from the female as t_{cal}= 0.888 with df = 68 is not significant at t_{tab} = 3.435at P > 0.05. This indicates that using structured-inquiry method produced no significant difference on gender. Therefore, the hypothesis is not rejected.

DISCUSSION

The result in Table 1 showed that treatment using structured-inquiry method produced significant difference on students' performance in basic science. This result is in

support of Schmid (2015) which showed that the achievement of students' exposed to structured-inquiry gained a significant short and long term increase in knowledge. Also, the result is in support of Guzel (2004), Uduosoro (2002), Owolabi and Oginni (2013) which revealed that students can acquire the best from learning when they were exposed to good teaching method. The result in table 2 produced no significant difference in the performance of male and female students taught basic science using structured-inquiry. This result agrees with Schmid (2015) which revealed that structured-inquiry method is suitable for both genders. Therefore, the use of structured-inquiry method in classroom instruction is a means of improving students' performance in basic science irrespective of sex.

CONCLUSION

The results of this study provide evidence that the use of structured-inquiry enhances students' performance in basic science. Therefore, the use of structured-inquiry could be a means of improving students' performance in basic science.

RECOMMENDATIONS

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

1. Since the commonly used conventional method of instruction has been empirically discovered in this study to be less effective than structured- inquiry method of teaching in improving junior secondary school students' academic performance in basic science, the conventional method presently in use by basic science teachers should be improved upon, modified and replaced with guided inquiry and other activity-based teaching approach.

2. Basic science teachers should be encouraged to adopt structured- inquiry teaching approach as this will expose the students to doing by themselves which is the foundation for tomorrow's scientists thereby leading to the development of our dear country, Nigeria since the needed man-power would have know the developmental rudiments right from their secondary school days.

3. State and Federal Government should equip all schools with necessary facilities for the application of structured- inquiry instruction.

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