



EFFECTS OF GUIDED INQUIRY TEACHING STRATEGY ON JUNIOR SECONDARY SCHOOL STUDENTS ACHIEVEMENT IN BASIC SCIENCE AND TECHNOLOGY, IN NASARAWA STATE, NIGERIA

ABSTRACT

The study investigated the effect of guided inquiry teaching strategy on JSS achievement in Basic Science and Technology in Nasarawa State. The design of the research is quasi experimental design. Three research questions guided the study and three null hypotheses were tested at 0.05 level of significance. The population consists of 1233 drawn from 29 Junior Secondary Schools in Akwanga Education Zone. The sample of the study comprised 278 students drawn from four (4) coeducational school using simple random sampling and stratified sample

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INTRODUCTION

Science and Technology have been described as the bedrock or the primary drivers of progress of nations and have constituted variable instrument that make material and human development. Akpan (2016) stated that nations at the forefront of modern development are those that have invested enormous resources over considerable time in the establishment and nurturing of a stable well supported science and technology education. Okeke (2015) stated that what divides the world today into developed and developing countries are the level of science and technology development therein which are attained through education of the citizenry. Ebe (2016) noted that there is the need for effective science and technology of the learner through good supportive skills by using a well-structured science curriculum.

Basic Science and Technology is indispensable in Nigeria Science Education Programme because it builds the basic foundation in pupils at the basic levels for the study of core science subjects at the post basic level. These are subjects are Biology, Chemistry and Physics (Nwanfor, 2017). In Nigeria a clear path for science project at the primary and junior secondary school levels has been the integration of subjects from the field of science and technology. The Nigeria Education, Research and Development Council developed a new curriculum to replace the existing one, the new curriculum led to the abolition of integrated science and introductory technology as teaching subjects in primary and secondary schools. This was replaced



method to obtain sample of 125 males and 153 female students. The research instrument used for data collection in this study was Basic Science and Technology Achievement – test (BTAT) on energy concept which developed by the researcher and administered to the students. Kuder-Richardson 21 formula was used to determine the reliability coefficient of BSAT, the coefficient of 0.80 was obtained. Means and standard deviation were used to answer the research questions while the research hypotheses were analysed using ANCOVA. The results show that students taught using guided inquiry method performed better than those taught using the lecture method. Male students taught Basic Science and Technology using both methods had higher mean achievement score than female counterparts taught Basic Science using the two methods. There is no significant interaction effect of gender and method on students mean achievement scores in Basic Science. Based on the findings of this study, it was recommended that teacher of Basic Science and Technology should use guided inquiry in teaching and learning of science.

Keywords: Achievement, Basic Science and Technology, Guided Inquiry, Teaching Strategy.

with basic science and basic technology respectively in 2015 (Awosanya 2015). The general objectives of basic science and technology education is to enable pupils/students observe and explore the environment using their senses and their hands. These objectives specifically aimed to enable the learner develop interest in science and technology, acquire basic knowledge and skills in science and technology, apply their scientific and technological knowledge and skill to meet their societal needs, take advantage of the numerous career opportunities offered by science and technology and become prepared for future studies in science and technology NERDC (2015). These objectives are enshrined in the basic science and technology curriculum, derived from the National Policy on Education (2016).

The design of the curriculum is based on the idea of spirality of themes which are arranged from year one to year nine (basic one to basic nine). In order to sustain the interest of learners, promote meaningful learning (NPE 2016). In spite of government efforts towards sustainable science education among Nigerian students' rights from basic level, the performance, enrolment and interest of students in science subjects is still very poor (Oludipe 2010).

The poor achievement in sciences indicated by various empirical studies (Ferdinand 2015, Betiku, 2012; Omole, 2013; NECO & WAEC 2012- 2015) have attracted the concern of all stakeholders including the researchers. Many factors have been identified and regarded as being responsible for the dwindling trend in the performance of students. These factors include; teachers' characteristics, social incentives, teaching methods and host of others Olatoye, 2011, Gunkola, 2016). This suggests that if the fore-listed factors and others can be taken into consideration, students will excel more in science generally and basic science in particular. Lack of use of appropriate teaching methods in teaching science have contributed to the students' poor achievement in science at the Junior Secondary School Omole (2013).

Teaching methods are the ways used by teachers to create learning environment and to specify the nature of the activity in which the teacher and the learner will be involved during instructional delivery process. It is primarily description of learning objectives, instructional activities and the flow of



information between the teacher and the learner. O. Bannon (2014) categorized teaching method into two approaches; namely student-centred approach and teacher centred approach. Teacher centred approaches are grounded in behaviourism and include all the teaching methods that see the teacher as possessor of knowledge. These methods include lecture method, demonstration, recitation etc. While student centred approaches are grounded in constructivism and include all the instructional methods underscores teachers as decision makers and problem solvers but rather as a guide in the learning process. The teacher acts as a guide and as a facilitator. The student is at the centre of the learning environment. The students are in control of their own learning and the power and responsibility are the students concern. Learning may be independent, collaborative, cooperative and competitive. Learning takes place in relative context and students are engaged in constructing their own knowledge (Theroux, 2012). Student involvement would include questioning, guiding, validating, monitoring, motivating, encouraging, suggesting, modelling, and clarifying (McKenzie 2005). This study will adopt the guided inquiry approach.

The inquiry-based learning is described as a range of philosophical curricular and pedagogical approaches to teaching. It is an instructional method developed during the discovering learning movement of the 1960s. It was developed in response to perceived failure of more traditional form of instruction, where students are required simply to memorize facts laden instructional materials (Bruner 1975). Inquiry method is a form of active learning where progress is assessed by how well students develop experimental and analytical skills rather than how much knowledge they possess. Guided inquiry provides specifics data or facts but wants students to make generalization; it is carefully planned, closely supervised, targeted ongoing assessment and intervention by an instructional team of a school. It allows students to discover specific information by themselves before they make generalization. There is no prescribed target result which the students have to achieve; rather students are allowed to discover facts for themselves (Okolie 2012).

Lecture teaching method is concerned with teacher being the controller of the learning environment. Power and responsibilities are held by the teacher and they play the role of instructor, and decision maker. They regard the students as having knowledge gaps that needs to be filled with information. According to Awodi (2012), the lecture method is mainly teacher centred with students being constantly passive and contents are constantly taught as absolute knowledge. Lecture method has its own advantages which include: it can be used to cover a large content area, at a time, it can be used to teach a large class. It has been observed that effective teaching may facilitate learning and make it more meaningful. In line with this, Sander (2012) stated that effective teaching helps the learner to learn better, while poor teaching would naturally lead to poor and constantly poor achievement.

Achievement according to Adeyemi (2016) is the scholastic standing of a student of a given moment. It has to do with successful accomplishment of goals. The purpose of testing an achievement is to help the teacher and the students evaluate the degree of success attained in learning a given concept. It is useful in testing retention of information and skill. It is equally appropriate in determining the efficiency of instruction. One of the issues at stake in education today is student's achievement measure in relation to teaching and the overall success of learning outcome, use of guided inquiry teaching method in teaching simple machine by basic science teachers may make Basic Science and Technology teachers may make the lesson objective stimulating and interesting to the students.



An issue of contention in Nigeria today is the issue of gender in our society including our education system. Gender issue was considered in this study because performance in basic science may be gender biased. Gender stereotyping in science has continued to receive much attention for many years. Okeke (2015) noted that the consequence of gender stereotyping cut across, social, economic, political and educational development especially in areas of science and technology. This has continued to receive research attention as studies on effect of gender in learning of science in general has remained inconclusive. Although, males and females differ in physical appearance, there have not been research findings to establish that they differ in mental abilities as a result of their gender. In recent times educators have expressed diverse views about gender and achievement especially in sciences. Some are of the view that males perform better than females while others disagree with this view, arguing that achievement is a factor dependent on several factors such as social economic factor, teaching methods among others. On the view of the above inclusive argument, the present research will investigate; The Effect of Guided Inquiry in JS Students' Achievement in Basic Science and Technology.

There is high rate of poor achievement of students in Basic Science and Technology in (JSSCE) Junior Secondary Schools Certificate Examination/Basic Education Certificate Examination (BECE) over the years. This could be as a result of teachers' use of ineffective method and strategies in science teaching which among others factors have contributed to the students' poor achievement in basic science and technology. This poor achievement has necessitated the need for seeking of improvement at the JS level. The available literature on methods of teaching in science education suggests the need to employ new innovative teaching strategies such as guided inquiring method. There is the need to explore more into the best method of teaching specific topics in basic science in order to enhance students' achievement. Therefore, the problem of this study is to find out what is the effect of guided inquiry and lecture method on students' achievement in basic science and technology.

Research Questions

1. What is the relative effect of guided inquiry and lecture method on students' achievement in Basic science and Technology?
2. What is the influence of gender on the mean achievement score of students taught using guided inquiry and lecture method?
3. What is the interactive effect of male and female mean achievement score in Basic science and Technology?

Hypotheses

The following hypothesis (H_0) were formulated to guide the study and will be tested at 0.05% level of significance.

- H₀₁** There is no significant difference in the mean achievement score of students taught Basic science and Technology using guided inquiry and those taught with lecture method.
- H₀₂** There is no significant difference in the mean achievement score of male and female students taught Basic science and Technology using the two methods.
- H₀₃** There is no significant interactive effect of teaching method and gender on students mean achievement score in Basic science and Technology.



METHODOLOGY

The design of the study is quasi-experimental design, non-equivalent control group design, because intact class was used to avoid disruption of normal classes. The area of study is Akwanga Local Government Education Zone, Nasarawa State which comprise 29 Junior Secondary Schools offering Basic Science and Technology. The population of the study is 1,234 JS II Students' drawn from four coeducational schools in Akwanga Metropolis. The sample of the study consist of four (4) public coeducational Junior Secondary Schools. The sample of the study consist of 278 Basic Science and Technology Students' drawn from the four coeducational schools. The research instrument used for data collection in this study was Basic Science and Technology Achievement Test (BTAT) on energy concept which developed by the researcher and administered to the students. Kuder-Richardson 21 formula was used to determine the reliability coefficient of BTAT, the coefficient of 0.80 was obtained. The scores obtained from the pre-test and post – test were analysed using mean and standard deviation to answer the research questions and Analysis of Covariance to test the hypothesis at 0.05 level of significance. ANCOVA was used because the experiment involved pre-testing of the subjects.

RESULTS

Results were presented in tables according to the six research questions and six hypotheses.

Research Question One: What is the relative effect of guided inquiry and lecture method on students' mean achievement scores in Basic Science?

Table 1: Mean (\bar{x}) and Standard Deviation (SD) Scores of Students' Mean Achievement Scores in Basic Science.

Group	N	Pre-test		Posttest		Mean gain Score
		\bar{x}_1	SD ₁	\bar{x}_2	SD ₂	\bar{x}
Guided Inquiry	47	38.96	11.63	65.72	16.63	26.76
Lecture Method	33	41.79	10.96	57.89	10.51	16.1

Note: N = Number of students SD₁ = Standard Deviation for Pretest, SD₂ Standard Deviation for Posttest, \bar{x} = Mean

The data on students' achievement in table 1 revealed that students taught Basic Science using guided inquiry method has mean score of 65.72 with standard deviation of 16.3 while the mean achievement score of students taught with conventional lecture method was 57.89 with standard deviation of 10.51. Also, the guided inquiry group had a gain score of 27.51 over the lecture group who had a gain score of 16.1 of students taught Basic Science using guided inquiry method therefore, performed better than students taught using the conventional lecture method.

Research Question Two: What is the influence of gender in mean achievement scores of students taught Basic Science using guided-inquiry and lecture method?

Table 2: Mean (\bar{x}) and Standard Deviation (SD) of influence of gender on students' mean achievement score in Basic Science.

Gender	N	Pre-test		Posttest		Mean gain Score
		\bar{x}_1	SD ₁	\bar{x}_2	SD ₂	\bar{x}
Male	42	41.08	11.23	65.11	15.58	24.03
Female	38	39.26	11.57	60.11	13.95	20.85

Note: N = Number of students SD₁ = Standard Deviation for Pretest, SD₂ Standard Deviation for Posttest, \bar{x} = Mean.



Data in table 2 revealed mean achievement score of 65.11 with standard deviation of 15.58 for male students, while the female students had gain score of 24.03 in Basic Science while their female counterparts had mean score 20.85 male students therefore, performed better than their female counterparts in Basic Science.

Research Question 3: What is the interactive effect of method and gender on student mean achievement scores in Basic Science?

Table 3: Mean (\bar{x}) and Standard Deviation (SD) on interaction effect of method and gender on the mean achievement scores of students in Basic Science.

Teaching	Pretest			Posttest			Mean Gain Score
	N	X	SD	N	X	SD	
Guided Inquiry							
Male	24	39.74	11.94	24	68.04	18.59	28.30
Female	23	23.21	11.53	23	63.11	14.56	25.29
Conventional Method							
Male	15	43.13	10.56	15	60.60	7.88	17.47
Female	18	40.67	11.81	18	55.61	12.04	14.94

The results in table 3 revealed a higher mean gain score of 28.3 for male students taught Basic Science using guided inquiry method, while their female counterparts had a mean gain score of 25.29. Male students who taught Basic Science with conventional lecture method had a mean gain score of 17.47 while their female counterpart has a mean gain score 14.94. The result does not suggest ordinal interaction effect between method of instruction and genders on students' mean achievement scores in science. This was because at all levels of the gender; the gain scores were higher for students taught Basic Science using guided inquiry method and the difference in the gain scores of male and female students in each group was tangible. The result showed that there is no interaction effect of gender and methods on students' mean achievement scores in Basic Science.

Hypothesis: There is no significant score of students taught Basic Science guided inquiry and lecture method.

Table 4: Analysis of Covariance of Students' Mean Achievement Scores in Basic Science

Gender of Variation	Sum of Squares	Df	Mean Square	F	Sig
Corrected Model	11613.487	4	2903.372	37.258	.000
Intercept	2623.714	1	2623.714	33.669	.000
Pretest	9974.333	1	9974.333	127.996	.000
Method	2128.256	1	2128.256	27.311	.000
Gender	146.749	1	146.749	1.882	.174
Method x Gender	1.156	1	1.156	0.15	.903
Error	5844.501	75	77.927		
Total	32983.000	80			
Corrected Total	17457.987	79			



Data in table 4 showed that there is a significant mean effect for mode of instruction on students' achievement in basic science $f(1,80) p < .000$. The null hypothesis therefore was rejected, indicating that there was significance difference in the mean achievement score of students taught basic science using guided inquiry method and those taught using conventional instructional method.

H₀₂: There is no significant difference in the mean achievement scores of male and female students taught basic sciences using the guided inquiry method and conventional method.

Table 4 revealed no significant mean effect of gender on students' achievement in basic science $f(1,80)$, $p > .174$. The null hypothesis was not rejected, indicating that there was no significant difference in the mean achievement scores of male and female students taught Basic Science using guided inquiry method.

H₀₃: There is no significant interaction effect of teaching methods and gender on student's achievement in Basic Science.

Data in table 4 indicated non-significant effect of teaching methods and gender on student's achievement in Basic Science $f(1,80) p > .903$. The null hypothesis was not rejected. The interaction effect of method and gender on students mean achievement scores in Basic Science therefore, not statistically significant.

Discussion

Students taught Basic science and Technology using guided inquiry method had higher mean achievement scores than their counterparts taught Basic Science using the conventional lecture method. The guided inquiry method may have been more effective because the instructions were characterized by active students' involvement, thereby capturing the interest of the students and maximizing comprehension of the subject matter. This is in the line with the observation of Nwagba (2012) and Ibe (2014) who indicated that inquiry approaches prove too improve student's achievement in sciences more than the traditional instructional methods like lecture, demonstration. Also, Timothy and Awodi (2013) revealed a significant difference between inquiry and lecture method in improving student's performance in biology achievement test in favour of the inquiry approach. The findings of this study are in line with that of similar studies by Ibe and Nwosu (2013) who carried out a study on the effects of guided inquiry and demonstration methods of teaching on science process skills acquisition among secondary school biology students. Their findings revealed that the students taught through guided inquiry method performed significantly better than those taught through demonstration and conventional (lecture methods).

Male students taught Basic Science and Technology using both methods had higher mean achievement score than female counterparts taught Basic Science and Technology using the two methods. This could be as a result of the different socialization processes of male and female students in which the male persons are expected to explore their environment while the female ones are to confirm or maintain their existing environment notwithstanding, male students performed significantly better than female students in Basic Science and Technology. The findings support the findings of Nwagbo (2012) who found out that male students performed better than counterparts in Biology. The finding did not support that of Ibe and Nwosu (2013) and others who found girls achieved more than boys in science subjects, and that female learners show some superiority over male learners. Obiekwe (2016) and Okoro (2011) also found that male students



achieve higher than their female counterparts in science, Okere (2015) and Nzewi (2010), are of the view that females achieve as high as their male counterparts when given equal opportunities. Ibe (2014) reported that there was no significant different in the achievement of male and female students used to determine the effect of guided inquiry and demonstration methods on science process skill acquisition among secondary school biology students. Male perform better than their female counterparts when taught with guided inquiry method probably because males tend to explore their environment more than their females who tend to conform to the environment, they found themselves.

There is no significant interaction effect of gender and method on students mean achievement scores in Basic Science and Technology. The findings of this study with respect to method of instruction agreed with the previous findings of Ibe (2014) who found no interaction effect between gender and treatment. In addition, Okwor (2015) found no interaction effect of gender and instructional treatment. Contrary to the findings of this study, Baser (2000) reports a significant interaction effect between gender and instructional treatment (cognitive conflict strategy) on students' conceptual change in physics using cognitive conflict instructional model. This showed that instructional method is not gender biased.

Conclusion

From the results obtained in the study on the guided inquire method on student's achievement in Basic Science and Technology, it was found out that: Student taught Basic Science and Technology using guided inquiry method performed better than their counterparts taught using the lecture method. Gender did not significantly influence students' achievement, even though the present mean scores of male students was slightly higher than that of their female counterparts. There was significant ordinal interaction between mode of instruction and gender on students' achievement in Basic Science.

Recommendations

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

1. In view of the fact that guided inquiry method was more effect in teaching Basic Science and Technology and enhancing students' achievement and interest in Basic Science, the Ministries of Education should ensure that textbooks authors incorporate guided inquiry methods in the instructional methods for secondary schools.
2. Mode of instruction had no differential effects on male and female student's achievement in Basic Science and Technology. Hence, teachers should make teaching and learning of science gender unbiased.
3. Ministry of Education should ensure that teachers are trained regularly on the use of innovative instructional approaches e.g., guided inquiry method.
4. The curriculum planners should ensure that they incorporate guided inquiry methods in Basic Science and Technology curriculum, as it will help to promote students' achievement and interest in the subject.



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