

EFFECT OF GUIDED DISCOVERY METHOD ON STUDENTS' ACHIEVEMENT IN BASIC SCIENCE IN SECONDARY SCHOOLS IN OLAMABORO LOCAL GOVERNMENT AREA OF KOGI STATE

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Abstract

The paper investigated the effect of guided discovery method on junior secondary school students' achievement in basic science in Olamaboro Local Government Area of Kogi State. A quasi-experimental design was adopted for the study. Two objectives, two research questions and two hypotheses guided the study. The population of the study was made up of all Junior Secondary School two (JSS II) students from the area of study. A total of eighty (80) students were selected by simple random sampling technique from two schools in the study area. The instrument used for the study was a Basic Science Achievement Test (BSAT). The reliability of the instrument was determined using Kuder-Richardson (K-R 20) which yielded a reliability coefficient of 0.78. Data were collected after administering the instruments to the students. Mean

and standard deviation were used to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the hypothesis at 0.05 level of significance. Findings from the study revealed that students taught basic science using discovery method did better than those taught using conventional method. The result further reveals that there was no significant difference in the achievement of male and female students taught using discovery method in basic science. It is recommended that basic science teachers should use discovery method to foster teaching and learning in basic science in order to enhance students' achievement in the subject.

Keywords: Achievement, Basic Science, Guided discovery method.

Introduction

Basic science refers to the integration of science subjects such as biology, chemistry, physics and mathematics with aim of teaching science from a unified approach. It was previously referred to as integrated science. The reform in Nigeria education system in early 2000 resulted into reviewing of 6-3-3-4 system of education to 6-9-3. This brought about some notable changes in several subjects curriculum such as the integrated science curriculum which was changed to basic science to broaden the objective and scope of the subject (National Policy on Education, 2014).

The subject was structured to assist learners to develop interest in science and technology. The aim is that by the end of the junior secondary school, presently known as basic 9, science and technological

education would have been introduced and the foundation laid for students' entrance into science and technology courses at senior secondary level of education as stated in the National Curriculum for Junior Secondary Schools (Obioma, 2012; Adeniyi, 2012). Furthermore, the national curriculum maintains that, the subject Basic Science and Technology which was previously Basic Technology is to be offered in junior secondary schools so as to reduce widespread ignorance about science and technology, lay a firm foundation for national development and inspire an increase in skill acquisition. Basic Science and Technology is a subject that introduces students at the junior secondary level of education in Nigeria, to the fundamental and basic in science and technology.

In Nigeria the secondary schools, basic science curriculum is designed to continue students' investigation into natural phenomena, to deepen students' understanding and interest in sciences, and also to encourage students' ability to apply scientific knowledge to everyday life in matters of personal, community, health and agriculture among others (Federal Ministry of Education, 2019). It is important to note that basic science curriculum for junior

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secondary schools have the objective of preparing students to acquire:

- i. adequate laboratory and field skills in basic science
- ii. meaningful and relevant knowledge in Biology
- iii. ability to apply scientific knowledge to everyday life in matters of personal and community health and agriculture.
- iv. reasonable and functional scientific attitude.

The framework of the New Basic Education Curriculum according to Adeniyi (2012) reflects the following:

1. The curriculum is designed to properly target pupils and students' needs and interests to make provision for appropriate core and elective subjects for a well-rounded education at the different age levels.
2. The lower and middle Basic Education curricula (for primary 1 to 6) will be in full use by the year 2014 and the upper Basic Education curricula (for JS 1 to 3) will be achieved by the year 2011.
3. Every child is expected to complete primary 6 before being placed in Junior Secondary (JS1).

Basic science is a very important science subject and stands as the bedrock upon which are based many other science courses like Medicine, Pharmacy, Nursing, Biochemistry, Genetic, Agriculture etc., that are of great economic importance to a nation. The relevance of basic science as foundation discipline for many science disciplines among other reasons account for the high enrolment of students in the Junior School Certificate Examination (JSCE). Despite the high number of students' enrolment in basic science in Junior School Certificate Examination, studies by (Adeyemi, 2018; Ige, 2019 and Chief Examiner's Report, 2017) have shown that students' achievement in basic science in the external examinations is poor. The poor achievement of students in basic science in external examination is linked to the use of traditional method (lecture method) in teaching secondary school basic science (Ige, 2019). The traditional/conventional teaching methods often used by teachers in teaching basic science include the lecture method, demonstration and direct instruction etc. These traditional methods of teaching stress more of the roles of the teacher than learner during science lesson. As a result, the use of traditional method does not

encourage science process skill acquisition needed for proper understanding of science principles, concepts and facts.

Guisti (2018) referred to these traditional teaching methods as teacher-centred approaches to learning in the sense that the teacher and those up in the educational hierarchy are considered as the possessor of knowledge to be transferred to the students, and as such decides how the knowledge transfer takes place. The shortcomings of these traditional teaching methods account for search for inquiry or activity based methods such as concept mappings, simulations and games, constructivism and discovery method for teaching and learning basic science (Mandor, 2012; Ibe, 2014; and Anyigbo, 2015). Discovery method is therefore considered necessary in this study, to determine its efficacy on students' achievement in basic science.

Another variable intended to be considered by this study include the influence of gender on students' achievement. According to Robert (2016) gender is a socio-cultural construct of ascribing characters and roles to sex such as male and females. Oludipe (2012) noted that the prevalent effects of gender bias and gender stereotypes in Nigeria affects certain vocations and professions such that traditionally professions like Medicine, Engineering, Architecture etc. are regarded as men's while Nursing, Typing, Catering etc. as women's. The stereotyping bias - that science is a male enterprise is of great concern in the field of science education and has resulted to a controversial issue and conflicting reports from different researcher. While previous studies by (Okeke, 2008; Oludipe, 2012, Ibe, 2014; and Ojobo, 2018) reported that there exist no significant difference in the achievement and interest of boys and girls in some science subjects. Hence, this study seeks to also find out if discovery method will have any effect on students' achievement in basic science with respect to gender.

Purpose of the Study

The following objectives guided the study.

1. Determine the effects of the guided discovery and conventional method of teaching on students' achievement in basic science.
2. Find out the effects of discovery method on achievement of male and female students in in basic science.

Research Questions

The following research questions were posed to guide the study:

1. What is the effect of discovery and conventional methods on students' achievement in biology?
2. What is the effect of discovery method on achievement of male and female students in basic science?

Hypotheses

The following hypotheses were formulated to guide the study and were tested at 0.05 level of significance.

- H₀₁. There is no significant difference in the mean achievement scores of students taught basic science using discovery method and those taught using conventional method.
- H₀₂. There is no significant difference in the mean achievement scores of male and female students taught basic science using discovery method.

Methodology

The design for the study is quasi-experimental. Specifically the study applied pre-test, post-test Non-equivalent control group design. The study was conducted in Olamaboro Local Government Area of Kogi State among Junior Secondary School Two (JSS II) students. Population for the study included all JSS II students. Eighty (80) JSS II students from two co-education secondary were selected by simple random sampling technique. That is, forty (40) students each from two schools (one experimental and one control schools).

The instrument used for the study was Basic Science Achievement Test (BSAT). The BSAT instrument consisted of 30 multiple choice objective questions developed by the researcher. The multiple choice question items were developed based on selected topics in basic science curriculum that were taught in the lesson. After trial testing of BSAT items, the reliability co-efficient obtained using Kuder Richardson formula (k-R-20) was 0.78.

Basic science teachers (Research assistants) in sampled schools assisted in two weeks of teaching topics in basic science using lesson plan on guided discovery method in experimental school and lesson plan on conventional method in control school. Pre and post-test were conducted for JSSII students in both experimental and control schools. The scores obtained from the pre and post-test were analysed using mean and standard deviation for research questions while Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance.

Results/Findings

The research questions were answered using mean and standard deviations while Analysis of Covariance (ANCOVA) was used to test the hypotheses at $P < 0.05$ level of significance.

Research Question I: What is the effect of discovery and conventional methods on students' achievement in basic science?

Table 1: Mean Achievement Scores of Experimental and Control Groups

Group	Method	Pre-Test		SD	Post-Test		Gain Score
		No.	X		X	SD	
Experimental	Discovery	40	7.78	2.25	17.20	2.61	9.43
Conventional	Conventional	40	7.15	2.34	12.40	3.14	5.25
Mean Difference			0.63	4.80			

Table 2: Mean Achievement Scores of Male and Female Student taught Basic science using Discovery method

Group	Method	Pre-Test				Post-Test		Gain Score
		Sex	No.	X	SD	X	SD	
Exp.	Discovery	Male	18	2.86	0.83	3.59	0.38	0.73
Exp.	Discovery	Female	22	2.65	1.11	3.76	0.40	1.11

Data in Table 1 shows that the pre-test mean achievement scores for experimental group and control groups are 7.78 and 7.15 with standard deviation of 2.25 and 2.34 respectively and mean difference of 0.63 at pre-test. While the post-test achievement mean scores for experimental groups and control groups are 17.20 and 12.40 respectively with standard deviation of 2.61 and 3.14 and mean difference of 4.80. The achievement gain score for experimental group (9.43) is higher than that of control group (5.25). This shows that discovery method had greater positive effect on students' achievement in basic science more than conventional method.

Research Question 2: What is the effect of discovery method on the mean achievement scores of male and female students taught basic science?

Data in Table 2 shows that the pre-test achievement means scores for male and female students taught using discovery method are 2.86 and 2.65 with standard deviation of 0.83 and 1.11 respectively with gain of 0.73. On the other hand, the post-test achievement mean scores for male and female students taught using discovery method are 3.59 and 3.76 with standard deviation of 0.38 and 0.40 respectively with gain score of 1.11. This shows that discovery method enhances female students' achievement in basic science more than the male students.

Test of Null Hypotheses

Hypothesis 1: There is no significant difference in the mean achievement scores of students taught basic science using discovery.

Table 3: Analysis of Covariance (ANCOVA) for the effects of Discovery and Conventional methods on students' mean Achievement scores in Basic science

Source	Type III sum of Squares	Df	Mean square	F	Sig.	Decision
Corrected	472.726a	2	236.13	28.387	.000	
Intercept	1736.664	1	1736.66	208.771	.000	
Pre-test	11.476	1	11.676	1.380	.244	
Method	472.099	1	472.09	56.753	.000	Not Sig.
Error	640.524	77	8.31			
Total	18636.000	80				
Corrected	1112.800	79				

a. R Squared = .424 (Adjusted R Squared = .409)

Table 4: Analysis of Covariance (ANCOVA) for effect of discovery method on mean achievement scores of male and female students' achievement in Basic science

Source	Type III Sum of Squares	Df	Mean	F	Sig.	Decision
Corrected Model	487.581a	4	Square	14.622	.000	
Intercept	1552.061	1	121.895	186.182	.000	
Pre-test	5.432	1	1552.061	.652	.422	
Method	452.876	1	5.432	54.326	.000	
Gender	15.288	1	452.876	1.834	.180	Not Sig.
Method * Gender	.024	1	15.288	.003	.958	
Error	625.219	75	.024			
Total	18636.000	80	8.336			
Corrected Total	1112.800	79				

a. R Squared = .438 (Adjusted R Squared = .408)

Data in Table 3 shows that the calculated value of F (56.75) for the effect of method on the achievement of students is 0.00. Since this value (0.00) is less than the 0.05 level of significance, the null hypothesis is rejected. Hence there is a significant difference in the mean achievement scores of students taught basic science using discovery method than those taught using conventional method. Thus, achievement was enhanced in favour of students taught using discovery method than students taught using conventional method in basic science lesson.

Hypotheses 2: There is no significant difference in the mean achievement scores of male and female students taught using discovery method in basic science.

Data in Table 4 shows that the calculated value of F (1.834) for the effect of gender on students' achievement is 0.180. Since this value is greater than 0.05 level of significance. The null hypothesis is accepted. Thus, gender has no significant effect on the students' achievement in basic science. Thus, there is no significant interaction effect between teaching methods (discovery method) and gender on students' achievement in basic science.

Discussion of the Findings

The findings as shown in Tables 1 and 3 revealed that discovery method had effect on students' achievement (9.43) more than the conventional method (5.25) with a mean difference of 4.80. Also, the calculated value of F (56.75) in Table 3 is 0.00 which is less than the 0.05 level of significance. Hence, the null hypothesis is rejected. This shows that there is significant difference on the on students' achievement in favour of discovery method than conventional method. The finding also in agreement with the findings of (Mayer, 2014; Kirshner, Sweller & Clark, 2016) who found out that guided discovery method is superior to conventional method in enhancing students' achievement. The finding is also supported with the constructivist's theory of Vygotsky (2012) who stated that instructional assistance and guidance enables a child to develop beyond the zone of proximal development. The findings as shown in Tables 2 and 4 revealed that the achievement gain scores for male and female students in experimental group exposed to guided discovery method were 3.59 and 3.76 respectively. The differences in achievement gain scores of male and female students in experimental groups shows that

even though the achievement gain scores of the female students were enhanced more than those of the male students it is insignificant. This finding agrees with (Chang, 2013; Roberts, 2016 and Kulthau et al., 2017) who stated that discovery method engage all students in active knowledge construction thereby fostering learning leading to better achievement among female and male students in basic science.

Conclusion

The paper investigated the effect of guided discovery method on students' achievement in basic science in Olamaboro LGA of Kogi State. There has been call in recent times for teachers to use appropriate teaching strategies to improve students' achievement in basic science due to the failure rate (Adeyemi, 2018). Hence, the need for this study. The findings after the investigation shows that discovery method enhanced achievement among students than conventional method in basic science. Also, guided discovery method foster achievement in both males and females in the subject. Therefore, basic science teachers should intensify the use of inquiry based strategies like guided discovery method to enhance better achievement among students in basic science.

Recommendations

Based on the findings of the study, the following recommendations are made.

- 1) Guided discovery method should be used more with conventional in teaching basic science lessons in the classroom. The use of guided discovery method in teaching and learning basic science will enable the students to develop inquiry skills needed for concept and knowledge construction which will help them to appreciate basic science better and improve on their achievements.
- 2) Basic science teachers should be trained and retrained on the job to employ the use of inquiry teaching methods like discovery method in the teaching and learning of basic science in the classroom. Training of these teachers could be done by the Government or relevant professional bodies like Science Teachers Association of Nigeria (STAN) through seminars, workshops and conferences.
- 3) The curriculum planners should plan the nation's basic science curriculum to accommodate an

inquiry based science programme for the students and should allot more time to basic science in the school time table to enable the application of inquiry methods like discovery method.

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