

## Comparative Effect of Guided Discovery and Discussion Teaching Methods on Basic Science and Technology Students' Achievement and Retention in Keffi Education Zone, Nigeria

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### Abstract:

*This study was designed to compare the effect of guided discovery and discussion teaching methods on basic science and technology students' achievement and retention in Keffi education zone, Nigeria. The study employed a Quasi-experimental research design where pre and post tests were used on settings outside the laboratory. The sample used for the study was 98 Junior Secondary II students. The study used two intact classes where one of the schools served as experimental group, while the other one was used as control group. Thirty (30) multiple choice test items were developed and validated by three experts in the Department of Science, Technology and Mathematics Education, Nasarawa State University, Keffi. The two intact classes were taught 6 topics, 3 in basic science and 3 in basic technology for a period of six weeks. Guided Discovery was used for teaching the experimental group while Discussion method was used for the control group. Data collected after the treatment was analyzed using means and standard deviations for the research questions while ANCOVA was used to test the null hypotheses at 0.05 level of significance. From the data collected, it was found that students who were exposed to guided discovery performed slightly better and retained more knowledge of the subject than those who were taught using discussion teaching method. However, the results of the hypotheses tests revealed that the differences in the mean achievement and retention scores of the two groups were not significant. Hence, the study recommends that the two methods could be used interchangeably for teaching basic science and technology in secondary schools in keffi Education Zone, Nigeria.*

**Keywords:** *Comparative effect, Guided discovery method, Discussion method, Approach, Basic science and technology, Teaching, Achievement, Retention.*

### INTRODUCTION

Science and technology play a vital role in the lives of individuals and in the development of a nation. It is widely and generally acknowledged that the gateway to the survival of any nation socially and economically is through scientific and technological literacy which can only be achieved through science and technology education. (Alebiosu and Ifamuyiwa, 2008).

Basic science and technology, formerly known as integrated science, is the first knowledge of science and technology which a child encounters at the junior secondary school level. Hence, basic science and technology curriculum prepares students at the; junior secondary school level for the study of core science and technical subjects at the senior secondary school level (Olaewaju, 1994). This implies that for a student to be able to study science and technical subjects at the senior secondary school level successfully, he/she has to be well grounded in basic science and technology at the junior secondary school level. In view of this, basic science and technology is being given greater emphasis at the junior secondary school in Nigeria.

In a bid to promote science and technology education, the Federal Government of Nigeria (FGN, 2004) in the National Policy on Education (NPE) came up with 6-3-3-4 policy on education which stipulates that a child

should spend six years at the primary school level, three years at the Junior Secondary School level, three years at the Senior Secondary School level, and four years in the University. This system of education was reviewed by the Federal Government of Nigeria in 2012 and came up with 9-3-4 system which stipulates that a child should spend 9 years compulsorily from primary school to Junior Secondary School level, three years at the Senior Secondary School, and four years in the University.

The above mentioned systems of education in Nigeria (6-3-3-4 and 9-3-4) have been designed with special provisions for learning science and technology in schools. To further promote the study of science and technology, the FGN (2012) has stressed in the same policy document that 60 percent of the students seeking admission into the nation's tertiary institutions should be admitted into science and technically-oriented programs, while the remaining 40 percent of the students could be admitted into Arts and Social Science programs. This is in a bid to encourage youngsters to elect the study of science and technology subjects. In this connection, educators are of the view that changes in students' outcomes must be supported by parallel changes in curriculum and methods of instruction (Ajibola, 2008).

However, it is apparent that many of today's teachers are caught in the web of change for which they may not have been professionally prepared. It appears too that many teachers were educated in the classrooms where the role of the student was to memorize information, conduct well regulated experiments and are then tested on their ability to repeat these tasks or remember specific facts memorized (Dogru and Kalender, 2007).

In an attempt to improve the standard of science and technical subjects teaching and learning, a lot of research studies have been carried out. Studies in basic science and technology education have reported that many students at the junior secondary school level or upper basic level (as it is sometimes called) have developed negative attitudes towards the study of the subject. At this level, perhaps, many students, because of their low interest and achievement in the subject, do not seem to benefit much from the basic science and technology curriculum (Olagunju, 1995; Akpan, 1996; Olanrewaju, 1999; Afuwape, 2003).

There are a variety of methods for teaching basic science and technology, namely, project method, field trip, enquiry, exposition, demonstration, experimentation, guided discovery method, etc. All these methods rely on various forms of teacher-student activities. However, some are more activity oriented than others. The Guided Discovery (GD), for example, has been recommended for teaching the contents of Junior Secondary School (JSS) basic science and technology curriculum by the Federal Government of Nigeria in its National Policy on Education (2012). This approach is activity based for both students and teachers. The method stresses the principle of effective questioning, appropriate directives and demonstration by the teacher, high quantity and quality of students' activities (laboratory work, inquiry, project, field trip and classroom discussion). Among these, guided discovery has been strongly advocated for teaching science and technical subjects. Researchers have argued about the superiority and effectiveness of guided discovery method over other learner-centered approaches. For example, reports from studies comparing students' achievement in competitive, individualistic and guided discovery learning show that guided discovery learning tends to produce higher results (Chiason, Kurumeh, and Obida, 2010; Ibinayin, 2014 & Ladan, 2016). However, this superiority has not been independently established in literature when compared with discussion method.

Classroom discussion is sometimes practiced in secondary schools during lessons especially in science and technology. These could be directed towards solving certain problems in science and technology. Agashe (2004), described this method as "middle-of-the-road teaching technique for instructors desiring to moderate levels of students' participation." Perhaps, it has been noted that if a teacher's primary purpose is to communicate specific and voluminous information to his students, the lecture method may be more appropriate. Also, if a teacher desires extensive participation by all members of the class in the lesson, it is often suggested that the class should be broken into smaller groups. Discussion implies involving the entire group in a topic under study. In this approach both the teacher and students collaborate to meet mutually set goals (Aronson, 2006).

Retention, according to the Oxford advanced learners dictionary (7<sup>th</sup> edition) is the ability to remember a piece of information acquired over a period of time. The longer the period a student remembers what has been learnt the better the retention and vice-versa. Over the years, a number of methodological problems confront researchers who have tried to investigate the trace decay theory. One of the major problems of researchers is controlling for the events that occur between learning and recall. Clearly, the time between learning something and recalling it could be filled with all kinds of different events which makes it difficult to ascertain that any amount of forgetting which takes place is as a result of the decay in knowledge rather than a consequent of other intervening variables. (Brown, 2004). Teaching methods or approaches, especially in the learning of science and technology are expected not only to enable students acquire knowledge but to retain same over a long period of time.

This study, therefore, set out to find out the effect of guided discovery and discussion teaching methods on the achievement and retention of junior secondary school students in basic science and technology in Keffi education zone of Nasarawa state, Nigeria.

### **Research Questions**

1. What is the difference in the mean achievement scores of JSS 2 students of basic science and technology when taught using guided discovery and discussion methods?
2. What is the difference in the mean retention scores of JSS 2 students of basic science and technology when taught using guided discovery and discussion methods?

### **Hypotheses**

1. There is no significant difference between the mean achievement scores of JSS 2 students taught basic science and technology using guided discovery and discussion methods.
2. There is no significant difference between the mean retention scores of JSS 2 students taught basic science and technology using guided discovery and discussion methods.

### **METHODOLOGY**

This study employed Quasi-experimental design of non-randomized pretest-posttest control group design. This is because the study used settings outside the laboratory and non-full laboratory control and laboratory isolation (Sambo, 2005). In this design, two intact classes were randomly selected from the schools in the area based on the results of the pretest. Out of the two schools selected, one was randomly assigned to the experimental group while the other was assigned to the control group. The number of students from each of the two intact classes was 50 and 48 making a total of 98. Six topics (3 from basic science and 3 from basic technology) were selected and taught for a period of six weeks in the two schools. The experimental group was taught using guided discovery method while the control was taught using the discussion method.

The instruments used for this study were the Basic Science & Technology Achievement Test (BSTAT) and the Basic Science & Technology Retention Test (BSTRT). Before the treatment, a pretest was administered on the schools in the area to identify two schools that were nearly homogeneous. After the treatment a posttest was then administered to the two groups to ascertain the effect of the methods on the groups. Four weeks after, a post-post test was administered on the groups to ascertain the level of retention of the knowledge acquired by the groups. The post-posttest was the same as the posttest except that this time around, it was reshuffled to serve as distraction to the students.

The instruments (BSTAT) and (BSTRT) were developed by the researchers based on the lower levels of Bloom's taxonomy because they are junior secondary school students. They were subjected to validation by three (3) experts, two in the Department of Science, Technology and Mathematics Education, and one from Educational Measurement and Evaluation unit in the Department of Educational Foundations at Nasarawa State University, Keffi. The logical validity index of the three experts yielded 0.86. Hence, the instruments were considered suitable enough for data collection.

To establish the reliability of the instruments (BSTAT) and (BSTRT), draft copies of the instruments were pilot tested on a representative sample of 30 students at Government College, Keffi; a school which was not part of the final sample. The test yielded reliabilities coefficients of 0.8 and 0.74 for the BSTAT and BSTRT, respectively. Mean and standard deviation were used to answer the research questions, while ANCOVA was used to test the null hypotheses at  $P < 0.05$ .

## RESULTS AND DISCUSSION

### Research Question 1

The data that was used to answer this research question is presented on table 1.

**Table 1: Mean Scores and Standard Deviations in Achievements of Students Taught Using Guided Discovery and Discussion Methods**

Teaching method	Type of test	No. of Students	Mean	SD	Mean Gain
Guided Discovery	Pretest	50	20.10	7.46	30.06
	Post test	50	50.16	7.99	
Discussion Method	Pre test	48	21.43	6.73	28.79
	Post test	48	50.22	8.99	

Table 1 shows the mean scores and standard deviations in the achievements of students taught using guided discovery and discussion methods. It is observed that the mean scores of students taught using guided discovery method is 20.10 in pretest and 50.16 in posttest, while their standard deviations are 7.46 and 7.99 for achievement test. Students who were taught using discussion method have the mean scores of 21.43 and 50.22 in pretest and post test respectively. Their standard deviations are 6.73 and 8.99, in achievement test. It was further observed that the mean gain scores for guided discovery and discussion methods are 30.06 and 28.79 respectively. This implies that the guided discovery method slightly favored students more than the discussion method of teaching.

### Hypothesis One

The data that was used to test this hypothesis is presented on table 2.

Table 2: Results of One Way ANCOVA test on Students' Achievement Scores in BSTAT in Guided Discovery and Discussion Teaching Methods

Source	Type III sum of squares	Df	Mean square	F	Sig.	Remarks
Model	681.415	2	340.708	5.176	0.007	NS
Intercept	16957.871	1	16957.87	257.60	0.000	S
Pretest	680.991	1	680.99	10.34	0.002	S
Group	18.450	1	18.45	0.28	0.600	NS
Error	6253.646	95	65.82			
Total	254140.000	98				

S = significant at  $P < 0.05$

Table 2 shows the summary of the one-way ANCOVA of the experimental and control groups on BSTAT. The results show that the p-value is 0.60 which is higher than 0.05. The null hypothesis of no significant difference is, therefore, upheld. This implies that there is no significant difference in the mean achievement scores of students taught basic science and technology by guided discovery and discussion method. Going by this result it may, therefore, be concluded that any of the methods can be used in the teaching of the subject in secondary schools.

### Research Question 2

The data that was used to answer this research question is presented on table 3.

**Table 3:** The Mean Retention Scores and Standard Deviations of BSTRT in Guided Discovery and Discussion Methods

Teaching method	Type of test	No. of students	Mean	SD	Mean Gain
Guided Discovery	Post-test	50	50.16	7.99	-1.49
	Retention	50	48.70	6.92	
Discussion	Post-test	48	50.29	8.99	-2.73
	Retention	48	47.59	7.05	

Table 3 shows the mean scores and standard deviations in using guided discovery and discussion methods of teaching. It is observed that the mean retention scores of students taught using guided discovery method were 50.16 and 48.70 in posttest and retention respectively. The standard deviation for the post test and retention are 7.99 and 6.92. For the discussion method, their mean stood at 50.29 and 47.56 for post test and retention and their standard deviations were 8.99 and 7.05 respectively. It was further observed that the difference between the mean retention gain scores for guided discovery and discussion methods are -1.49 and -2.73 respectively. This implies that there is a drop in knowledge gain for students who were exposed to guided discovery by -1.49, while those exposed to discussion method had a drop in knowledge by -2.73 which also signify a decay of knowledge, but this was more in the discussion method.

### Hypothesis Two

The data that was used to test this hypothesis is presented on table 4

Table 4: Results of One Way ANCOVA test on Students' Retention Scores in BSTRT in Guided Discovery and Discussion Teaching Methods

Source	Typell1 sum of square	Df	Means square	F	Sig	Result
Corrected Model	31.722	2	15.866	0.322	0.73	NS
Intercept	6227.092	1	6227.092	126..289	0	S
Post test	.044	1	0.044	0.01	0.98	NS
Group	31.667	1	31.667	0.642	0.43	NS
Error	4684.268	5	49.308			
Total	231854.000	98				
Corrected total	4716.000	97				

S =Significant at  $P < 0.05$

Table 4 shows the summary of the one-way ANCOVA of the experimental and control groups on BSTAT. The results show that the p-value is 0.43 which is higher than 0.05. The null hypothesis of no significant difference is, therefore, upheld. This implies that there is no significant difference in the mean retention scores of students taught basic science and technology by guided discovery and discussion method in junior secondary schools. Going by this result it may be said that any of the two methods could be employed to teach the subject in junior secondary schools.

## DISCUSSION

From the results of this study, it was found that students who were taught using guided discovery performed slightly better than those who were taught using discussion teaching method as indicated by the mean scores and standard deviations of the two groups. Also, students who were taught using guided discover method recorded a slightly lower decline in their retention of the knowledge acquired compared to their counterparts who were taught using discussion method. There was, however, no significant difference in mean achievement and retention scores of students taught using guided discovery and those taught using discussion method. This implies that guided discovery and discussion methods have virtually the same effect on students' achievement and retention in basic science and technology. The implication of this finding is that the two methods could be used inter-changeably for teaching basic science and technology in secondary schools.

The above findings are in contradiction with that of Chianson, Kurumeh and Obida (2010) who investigated the effect of guided discovery learning method compared with the conventional (lecture) method in the achievement and retention levels of students in circle geometry and found that students who were taught using guided discovery strategy achieved better and retained concepts learnt far longer than students taught using conventional method.

The present findings are also in partial agreement with that of Ibinayin (2014) who undertook a study to compare the effect of small group discussion with that of traditional or lecture method on the mean achievement and retention scores of junior secondary school students in Algebraic Word Problems. In the study, he found that while there was significant difference in the mean achievement scores between the students taught using the two methods in favor of the guided discovery, there was, however, no significant difference in the mean retention of the two groups. Similar to the later finding, the present study also found that there is no significant difference in the mean retention scores of the two groups on the basic science and technology retention test. The

only difference between the two studies is that while the former was on Mathematics the present is on basic science and technology. The findings of the two studies could be collaborated since they are all in sciences.

## CONCLUSION

The findings of this study have shown that even though there are slight differences in the mean achievement and retention scores between the two groups after treatment, the differences so observed are not significantly different which implies that Guided Discovery and Discussion teaching methods are both complimentary and can be used interchangeably for effective teaching of basic science and technology curriculum in junior secondary schools.

## RECOMMENDATIONS

1. Activities related to Guided Discovery and Discussion teaching methods should be organized by teachers to enhance learning of basic science and technology in junior secondary schools.
2. Workshops/seminars should be mounted by schools to further prepare teachers on how to effectively use the two methods for teaching and learning of basic science and technology in secondary schools.
3. Curriculum developers should include the two methods in the curriculum of basic science and technology to guide teachers on when to use any of the methods in teaching basic science and technology in junior secondary schools.

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