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Effects of Inquiry and Lecture Methods of Teaching on Students' Academic Performance and Retention Ability Among N.C.E 1 Chemistry Students of Federal College of Education, Zaria

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ABSTRACT

This study investigated effects of inquiry and lecture methods of teaching on students' academic achievement and retention ability among N.C.E 1 Chemistry students of Federal College of Education, Zaria. The study is a pre-test, post-test quasi experimental control group design. A total of 256 students formed the sample of the study which was selected in line with Krejcie and Morgan (1970) sample size table. A Separation Techniques Chemistry Achievement Test (STCAT) was used for data collection. The STCAT was developed by the researcher and validated by experts in chemistry education. The reliability coefficient of STCAT was found to be r=0.88. Analysis of data using t-test statistics shows that the experimental group which was taught chemistry using inquiry teaching methods performed significantly better than the control group which was taught using the traditional lecture method. Other findings of the research were that inquiry method of instruction was gender-sensitive and that it enhances retention. The study recommends, among others, that chemistry teachers should be encouraged to use inquiry method in the teaching of chemistry.

Keywords: *Inquiry, Lecture Method, Academic Achievement, Retention Ability, Chemistry Students.*

INTRODUCTION

The principal objective of education has been the development of the whole individual. The hope of every seasoned parent is that the school will be able to develop the child's potentialities in life. The only way to achieve this is by giving the child education that is of high quality and standard. Education involves the total efforts of the community to raise its political, social and economic standard of living. The implication of this is that it is an inevitable tool for surmounting ignorance, disease, poverty and to produce functional individuals who have positive attitudes towards the growth and development of the society.

The development of any nation depends largely on the level of its scientific and technological literacy. Chemistry which is one of the sciences is indispensable to technological advancement. Chemistry has helped in the development of modern technology through the application of its principles to modern invention. Its study enhances an understanding of the interplay of forces in nature because it forms veritable arm our against superstition which muddles technological advancement anywhere. Chemistry as a course of study is perceived generally to be very interesting, vast, mathematical and experimental Almost all aspect of life science, both living and nonliving has something to do with chemistry, ranging from engineering to mathematics, biology, physics. Chemistry is one of the pre-requisite subjects for the study of engineering, technological, medical and other applied science courses in the university the study of chemistry has been and will remain of tremendous importance to mankind because it is capable of explaining natural phenomenon and everyday occurrences. The implication of this is that Nigeria cannot develop technologically if the

subject Chemistry is not taught effectively in our secondary schools.

In spite of the Federal Government's efforts in trying to promote the teaching of chemistry in our secondary schools by providing science equipment, employing chemistry teachers and even sending chemistry teachers on in-service training, Chemistry achievement still remains deplorable. This has resulted in poor performance of students in the subject. The poor performance of students in the West African School Certificate Examination as confirmed by the West African Examination Council Chief Examiners report (2000-2009) has caused concern to many well-informed Nigerians. This has led many researchers in chemistry education to search for the cause of this poor achievement in the subject and possible solutions to this problem.

One of the objectives of science education is to develop students' interest towards science and technology. The development of any nation today depends on its technological and scientific advancement. Teachers are expected to device ways of motivating their students to develop positive attitudes towards science and science related disciplines (Sola &Ojo, 2007). Inquiry teaching Method is a style or method of teaching where the learner is seeking to discover and create answers to recognized problems through procedure of making a diligent search, some time with minimum guidance from the teacher (Callahan, Clark & Kelloough , 1995). Inquiry teaching method is also a term used in science teaching that refers to a way of questioning, seeking knowledge or information or finding out about phenomena, it involves investigating data and arriving at a conclusion (Sola &Ojo 2007). In inquiry situation students learn not only concept but also self-direction, responsibility and social communication. It also permits students to assimilate and accommodate information. According to Sola and Ojo (2007), inquiry is a way people learn when they are left alone.

Structured inquiry is the most teacher-centered of the three types of inquiry. This type of inquiry is commonly seen in science classrooms in the form of laboratory exercises. The teacher provides fairly structured procedures for the inquiry activity, and students carry out the investigations. Structured inquiry could be described as the most traditional approach to inquiry (Cheval & Hart, 2005).

On the far side of the spectrum is an open inquiry. This type of inquiry requires the least amount of teacher intervention and is student- centered. Students often work in groups and plan all phases of their investigations. This is the purest form of inquiry conducted in science classrooms (Cheval & Hart, 2005).

Guided inquiry falls in the middle of the inquiry instructional spectrum. This approach is commonly used when students are asked to make tools or develop a process that results in a desired outcome. For example, a science teacher gives his SS 2 students materials to create a rocket but no instructions for designing the rocket. The students must use their own knowledge and creativity to design the rocket so that it will launch properly, fly a certain distance, and land without becoming disassembled. The teacher provides the problem and materials and the students develop the rocket using their own scientific process or Procedure.

In this study guided inquiry was used and students were given topics and materials they developed method to find answers to the problem given to them.

Lecture method is used primarily to introduce students to a new subject but it is also a valuable method for summarizing ideas, showing relationship between theory and practice and re-emphasizing main points (Sola &Ojo, 2007). Lecture-demonstration method is a teaching technique that combines oral presentation with doing to communicate process, concepts ideas and facts, observation. It is particularly effective in teaching a skill that can be observed (Sola &Ojo, 2007).

Retention means storage of information over some period of time, this time period is called retention interval (Bichi, 2002). If for some reasons, the subject is unable to produce the response at the end of the retention interval forgetting has occurred. The more active the learner is in the leaning process the better he or she retains what is taught (Paul, 1999). According to Johnson and Johnson (1990), learning through inquiry activities enhances elaborative thinking and better understanding which lead to more meaningful learning. This has the potential of increasing depth of

understanding, the quality of reasoning and the accuracy of long term retention. In this study the effectiveness of inquiry teaching method on retention ability of the students was investigated.

Permanent and meaningful learning is the target of educational endeavor. Understanding and retention are the products of meaningful leaning when teaching is effective and meaningful to the students (Bichi, 2002). Retention is defined as the ability of one to remember what he has learned in the later time, it takes place when learning is coded in to memory. Thus appropriate coding of incoming learning, or in coming information provides the index that may be consulted; so that retention takes place without elaborate search ability retains and consequently remembers what we have been experienced, or what we have in the memory (Oyedokun, 1998). There are several factors that influence retention.

According Blair and Simon (1998) anything that aid learning should improve retention while things that lead to confusion, or interference among learning materials decrease the speed and efficiency of learning and accelerates forgetting. Interference may exist in several forms such as retroactive inhibition, or emotional inhibition. Retroactive inhibition result, when things are learned, the result of that leaning usually occurs after a passage time. In the intervening period many other things are learned. These interpolated learning interfere with the memory of the original materials and the interference is known as retroactive inhibition (Blair & Simon 1908). Many studies carried out on gender effect on academic achievement have led to number of conciliating conclusions, some find gender as a relevant fashion in academic achievement, others found that there is no difference exists between the sexes in this area (Bunkure,2007). Generally, there has been great participation of males in science course and careers.

In Nigeria, Jegede (1981) shows that there is a significant deference in academic achievement between male and their female counterparts with boys achieving higher than girls. (Mekeache, 1981) was not incomplete agreement with Jegede's findings. He showed that the performances of students in co-educational schools were better than those in single sex schools, that is, all boys or all girls.

(Mekeache, 1981 showed that girls had better scores in chemistry than boys in single sex school (all boys or all girls). Greenfield (1995) determined whether the gender difference has any effect on decision to enter science project topics. She examined science and engineering students and concluded that:

- Female are more likely now than 20 years back participating in science.
- Females' representation in the physical science has increased over the years.
- Engagement of females in physical science projects, such as earth science and mathematics is still less than that of males.
- Females tend to avoid project in scientific inquiry and experimental research in state of this, they prepared library base research.

In her study of science achievement, Greenfield (1996) concluded that; males are more interested in studying sciences than females.

Laboratory skills or science-process skills have shown to have some positive effect on the student's academic achievement. Students taught with inquiry-base teaching method show better academic performance then those taught with lecture method (Basega, 1994). Laboratory teaching assumes firsthand experience in observation and manipulation of materials. Inquiry based instructional method is associated with laboratory instruction which is often emphasizes the science process skills.

According to Song long (1998), inquiry-based instruction produces positive outcomes on student's concept learning, especially at higher cognitive levels of Blooms taxonomy of education. A modern technique of research is meta-analysis in which a group of studies is analyzed for similarities and differences in finding related to their common trust.

Inquiry teaching method was chosen in this study due to its scientific nature and it is student- centered and it involved all scientific

process (Sola & Ojo 2007).In this study the effects of inquiry and lecture methods of teaching on students' academic achievement and retention ability among N.C.E 1 Chemistry students of Federal College of Education, Zaria was investigated.

Statement Of The Problem

Chemistry being a core subject In the study of sciences and engineering should be given a special consideration. Many students find chemistry to be a hindrance in attaining their aims and objectives (Donald, 2000). For example; students wishing to read medicine cannot do so unless they perform well in chemistry. It is therefore necessary to properly guide and teach the students better in order for them to perform better in chemistry for a better attainment of their future career.

To this end, the United Nations Education Scientific and Cultural Organization (UNESCO) and the International Union of Pure and Applied Chemists (IUPAC) have participated in numerous international meetings to promote inexpensive experimental-based teaching in chemistry. (German, 1989).

Performance of students in science subjects, particularly chemistry, has assumed a serious dimension as reported by West African Examinations Council (1999). In the light of this, science teachers need to seek suitable ways of tackling the current massive failure in chemistry if they are to halt the drifts of science students to art and social science subjects (West African Examinations Council Report, 1999). The same mass failure is being experienced even in our tertiary institutions especially Federal College of Education Zaria. This can be seen from the examination results of Department of Chemistry, school of science from 2010 – 2016, shown in Table 1

Table 1: *Showing Number of Students Enrolled and Sat for Examination with their % Performance*

Session	Total number of students enrolled in the program	Total number of students that sat for the examination	Pass (%)	Failure (%)
2010/2011	300	251	182 (73)	69 (27)
2011/2012	400	335	155 (46.3)	180 (53.7)
2012/2013	350	326	266 (81.6)	60 (18.4)
2013/2014	640	592	429 (71.38)	172 (28.62)
2014/2015	650	573	311 (72.83)	172 (27.17)
2015/2016	1000	733	441 (60.16)	292 (39.84)

***Source**: Examination Office, Chemistry Department, F.C.E, Zaria, 2016*

The inquiry teaching method developed in this study specifically emphasized gathering and interpreting data by the students in cooperative learning setting with the goal of improving students learning of chemistry content.

Inquiry teaching method was chosen in this study because; even though it is highly scientific in nature it is seldom practiced in our tertiary institutions (Sola &Ojo, 2007).

This study motivates the use of inquiry teaching in the teaching of chemistry in Federal College of Education, Zaria, with the view of improving the performance of students and promoting meaning full teaching and learning.

According to Ibrahim, (2006) Separation technique is a concept that helps students and chemists in separating various compounds from a mixture, therefore the concept should be properly understood, N.C.E I were used in this study because at this level students were well exposed to chemistry courses using traditional lecture method. They are also familiar with school environment, laboratories and the instructors.

Research Questions

The following research questions guided this study:

- What are the effects of inquiry teaching method on academic performance of N.C.E I chemistry students of Federal College of Education, Zaria.
- What is the effect of gender on the academic performance of male and female students taught Separation techniques using inquiry teaching method?

Null Hypotheses

The following null hypotheses were formulated and tested in the course of the study.

HO1: There is no significant difference in means scores of students taught chemistry

concepts using inquiry teaching methods and those taught the some concept using lecture method.

HO2: There is no significant difference in means scores of male and female students taught separation technique using inquiry teaching method.

Significance Of The Study

The world in general is becoming increasingly scientifically and technologically oriented. Nigeria is also moving in that direction. The role of laboratory technologist in this scientifically developed world can be not be over emphasized. The Laboratory Technicians/Technologist is trained personnel's who are trained to handle laboratory equipment in schools, colleges and even universities. They also work in medical laboratories.

It is clear that the course is purely practical and not theoretical and one of their major courses is Chemistry. In view of these there is need for proper teaching method in order to train people that will be able to do the expected jobs. This study is significant to the development of retention ability of N.C.E 1 students of Federal College of Education, Zaria, since they are potential teachers; they need to be familiar with such a concept for better dissemination of the message to their students.

This study is geared toward determining the effects of inquiry and lecture methods of teaching on students' academic achievement and retention ability among N.C.E 1 Chemistry students of Federal College of Education, Zaria.

And it also determines whether the inquiry is gender friendly or not, with the view of improving the quality of teaching and learning among N.C.E I chemistry students of Federal College of Education Zaria.

The finding of this study has the following significance:

- To facilitate understanding of chemistry among N.C.E students and enhance the students' academic performance.
- To be useful to both staff and students of Chemistry department Federal college of Education, Zaria, Chemical Society of Nigeria (CSN) and the general public.
- It is also hoped that science based organizations like Science Teachers Association of Nigeria (STAN), Mathematics Association of Nigeria (MAN), National Educational Research and Development Council (NERDC) etc will find the findings useful.

Research Methodology

The one-group pretest post-test and quasi-experimental design was adopted in conducting this study. The study involved only a group of students who were tested before and after treatment. The population of the study consist of seven hundred and thirty three N.C.E I chemistry students. A total of 256 respondents from N.C.E I were used in this study. Sample size was chosen in line with Krejcie and Morgan, 1970 sample size table. This is to make sure all students are duly represented in the study. The instrument used for data collection was Separation Techniques Chemistry Achievement Test (STCAT). The (STCAT) was used in assessing the sample's, pretest and post-test. The (STCAT) was based on the concept of separation technique. It consists of 20 multiple choice questions followed by five (5) options A—E students were asked to circle the correct option. The instrument was validated by experts from the department of chemistry Federal college of education, Zaria.

A reliability test was conducted to determine the reliability of the instruments using PPMC (Pearson Product Moment Correlation), a correlation coefficient of 0.88was obtained which makes the instrument reliable for the research; the data was obtained within three (3) weeks.

The data obtained was analyzed using T-test using the statistical package for social sciences version 20 (SPSS version 20)

Results and Discussion

HO1: There is no significant difference between the mean scores of students taught chemistry concepts (separation technique) using inquiry methods and those taught the some concept using traditional lecture method. The students' retention ability was tested using the post-test means scores of the experimental group, which from the results analysis shows

great development in terms of academic performance. The post test data of the experimental and control groups were generated via STCAT and were subjected to t–test statistical analysis to determine if there is any significant difference in academic achievement of students in the experimental and their counterparts in the control groups.

Summary of the analysis is presented in Table 2.

The result obtained in table 2 shows that there is a significant difference between the post-test mean scores of the experimental and the control groups in favor of the experimental group. Thus the null hypothesis is rejected. This implies that the experimental group taught chemistry using inquiry method of instruction achieved significantly higher than the control group taught same concepts using lecture method since the alpha level of significance was found to be 0.000 and P is Significant @ P≤ 0.05 .

This had answered the first research question that is there is a significant difference in the mean scores of the students taught chemistry concepts using inquiry teaching method and those taught the same concept using lecture method.

Table 2.*T- Test Analysis of the Post-Test Mean Scores of the Experimental Group (EG) and Control Group (CG)*

Variable	N	X	S.D	S.E	Df	t- value	P	Remarks
Control Group	128	5.29	1.095	0.097	127	54.642	0.000	Sign.
Experimental Group	128	9.52	1.011	0.089	127	84.153		

Significant @ P≤ 0.05

HO2: There is no significant difference in academic performance between male students taught separation techniques using inquiry method of teaching and their female counterparts taught same using the same teaching strategy.

To test this hypothesis, the post-test achievement scores of the experimental group were split according to sex of the subjects in the group and compared accordingly. The mean scores of the male and female students who were exposed to the inquiry method of instructions were subjected to t-test statistical analysis. The results obtained are shown in Table 3.

Table 3: *T- Test Analysis of the Post-Test Mean Scores of the Male and Female Students in the Experimental Group*

Variable	N	X	S.D	S.E	Df	t- value	P	Remarks
Male	64	5.31	1.207	0.151	63	35.217	0.35	Sign.
Female	64	4.67	1.544	0.193	63	24.213		

Significant @ P≤ 0.05

From the result obtained in table 3, it is shown that both Male and Female students perform at same pace since the alpha level of significance was found to be 0.35 and P is significant @ P≤ 0.05 therefore, the null hypothesis is retained.

This means there is no significant difference in the academic performance of the male and female students of the experimental group exposed to inquiry teaching method.

This implies that both male and female students performed equally well after exposure to Inquiry teaching method, and it is concluded that Inquiry teaching method is gender friendly. This also answered the second research question that is inquiry teaching method had no effect on the gender of the students.

SUMMARY OF FINDINGS

- Analysis of data to test HO1 shows that there is a significant difference in the means scores of the experimental group and control group in favor the experimental group which implies that inquiry teaching method was more effective instructional strategy then traditional lecture method.
- Analysis of data used to test HO2 indicates that the performance of male and female students is equal when exposed to inquiry teaching method in Chemistry, which means that inquiry teaching method is gender friendly.

CONCLUSIONS

From the finding of this study, the following conclusions were drawn:-

- Instructional strategies that teachers use in the teaching of science have significant effects on the students' achievement.
- Inquiry teaching method facilitates effective learning of separation techniques.
- Students that were taught chemistry concept using inquiry teaching method retained the learned concepts better than those taught using traditional lecture method.

RECOMMENDATIONS

On the basis of finding emanated from this study, the following recommendations are made:

- The teaching of chemistry should be conducted in such a way that students effectively learn and retain the concepts presented to them. The use of inquiry method seems to be appropriate in that respect. It should, therefore be incorporated into the main stream of pedagogy in the teaching of chemistry in institutions of higher learning.

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