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## Effect of Guided Discovery Instructional strategy on the academic achievement and retention among chemistry students on NCE 1 in volumetric analysis in Federal College of Education (FCE) Obudu

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### Abstract

The study investigated the effect of the Guided Discovery Instructional Strategy on academic Achievement and Retention among Chemistry Students of NCE year 1 in volumetric analysis in F.C.E Obudu. Quasi-experimental Pretest-Posttest was the design used. The population of the study was made up of both male and female students totaling five hundred and twenty (520). The instrument used was a designed test questions on Chemistry Volumetric Analysis Test (CVAT). The test items were validated by experts in test and measurement Department in the Faculty of Education UNICAL and Chemistry Department, F.C.E Obudu. A reliability coefficient of 0.65 using Cronbach Alpha was used. Four research questions were raised and answered using mean and standard deviation statistical method. The results showed that, in the identical circumstances and settings, students instructed via the guided discovery method performed better than those taught using the traditional lecture style. The study also showed that when educating both sexes utilizing the Guided Discovery technique, there is no discernible difference in the academic performance of males and females. The study also shows that there was an important distinction in retention ability between the conventional lecture approach and the guided discovery method for all students. Result of the study showed that guided Discovery method is preferable in teaching Sciences (Chemistry) than lecture method in volumetric analysis. Recommendations were made showing clearly that the Guided Discovery method should be applied by science teachers in Nigeria because, it is effective in achievement and retention by students and also that, it does not create disparity in gender level of achievement and retention, thus it should be enshrined in the Science curriculum of studies in Tertiary Institutions in Nigeria.

**Keywords:** Guided Discovery, Achievement, Retention

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## 1. Introduction:

Science is the fulcrum to the development of society in particular and the nation in general. It is a conglomerate of three basic disciplines namely, Biology, Chemistry, Physics as well as Mathematics which is used as the Language of Science (Galileo Galilei 1564 – 1642). Science has its importance on health, technology, engineering, human rehabilitation and improvement in living such as Agriculture, Forensic development and Security, according to Anaso (2015). This enormous role of Science in developed and developing Nations like USA, Nigeria have a great role to play in order to create a mental, economic and social equilibrium both in the classroom and its effects on society and value of man. Consequent upon this, Science teaching in Nigerian schools is absolutely necessary. In the past, it has been a mere acquisition of knowledge by rote learning. In relation to this, Anaso (2015) noted that, most activities in Science teaching then were beyond the experience of the Nigerian students adding that, instructional strategies used during that period were classical and the emphasis was on rote learning. Nigeria in order to improve Science teaching a body known as Science Teachers Association of Nigeria (STAN) was formed on 30<sup>th</sup> November, 1957 when it was first coined by eminent scholars.

Science teachers give lessons and direction to assist students investigate and comprehend key principles in science, such as how to solve problems and obtain data to back up claims. Science instructors prepare class plans, conduct demonstrations, and mark homework and assessments.

The fundamental goal of technology and science is to advance society by generating new ideas and information, applying that knowledge to improve human well-being, and resolving the different problems that society faces. As a result, the interaction between science, technology, and society can be compared to a rainstorm that falls on a mountain but does not instantly pour down hillsides. The forest first absorbs it and stores it, allowing trees and other vegetation to grow and creating a lush landscape. This can therefore be likened to the body of information that science has amassed and the ongoing pursuit of the truth discovered through fundamental study, which suggests that science has inherent value. This circumstance is comparable to the body of information that science has amassed as well as the ongoing pursuit of truth through fundamental analysis of facts, data, concepts, and inventions. When comparing this circumstance to the variety of scientific and technological development based on scientific information that can result in the planning of different new technological strategies, it is also impossible to rule out. This is comparable to studying and producing useful innovations that

improve people's lives and society's prosperity (F.Y. 2003).

In a broad sense, Science can be classified into Formal Sciences and empirical Sciences. Formal science is defined as being formal; its main focus is on arguments, contents, and methods that adhere to strict guidelines. According to Nwala (1999) and Anaso (2015), findings and conclusions are legitimate and authentic as long as they follow the rules. This means that the body of knowledge must be systematic, consisting of straightforward terms and concepts, fundamental premises or assumptions, rules of inference, and a formula that leads to a logical conclusion. However formal Science include Mathematics, theoretical Physics, statistics, Arithmetic, geometry, and logic (Galileo, 2019).

Empirical Science center's mainly on material drawn from experience. It addresses with physical objects and phenomena that may be seen by any sense (sensory organs) and examined by tools like those for measuring volume, size, height, and insight. The nature and operation of things or phenomena, such as the body of a person, the weather, illnesses, the bodies of plants and animals, are the subject of empirical science. Example of empirical Science include Physics, Biology, Chemistry, Biochemistry, Ecology, Medical Sciences, Psychology, Sociology, Microbiology and Botany according to Agbi (2004). Empirical Sciences entails observation and experimentation with a view to finding out how things originate, develop (grow) function or relate to each other. Empirical Sciences entails observation which include inductive generalization, theories and laws that are formulated in clearly defined terms, statements, prepositions or in statistical equations and formulas (Agbi, 2004). This is therefore, the area at which volumetric analysis is grouped, and thus a well-defined teaching method has to be deployed to achieve a credible result.

However, the attention of this piece would be centered on empirical Science which is classified under physical Science namely; Chemistry – which deals with the composition, properties and uses of matter. The quantification of this matter in volume is simply called Volumetric analysis and how effective it is on the achievement and retention of N.C.E 1 Chemistry students in F.C.E Obudu. The empirical deduction would be summarized based on the articulate projections guiding the study.

The present state of Chemistry Education in tertiary institutions in Nigeria is not quite satisfactory as it's evident in student's constant failure or poor academic achievement in examinations as revealed by Okoli, (2006), Osorbone, (2005), in Anaso (2015). Studies from different Science educators Okafor (2002), Alcuezulo and Chimeoke, (2009) in Anaso (2015).

WAEC Chief Examiner (2020), report have found that, some specific variables have led to its poor performance. These variables according to them include, poor pedagogy, organization of practical experiments for students in Chemistry by Chemistry teachers, Psychological factors, and the abstract nature of the subject.

## 2. Review of Literature:

A study by Akin (2007) suggested that, there is the need to sustain student's posture interests in order to improve achievement and retention in Volumetric analysis (quantitative analysis).

Obikue (2009), study revealed that, the lecture method of instruction is still in use by many of the Science teachers. It was noted by this scholar that, rote learning is the major factor playing down on effective learning of Science among students. Usman (2000) in Anaso (2015) noted that activity-based method of teaching promotes academic achievement of students. Based on this, the researchers were prompted to seek an alternative instructional strategy that will result in learning achievement and retention among students. One of such strategies is "The Guided Discovery Instructional method of delivery.

Guided Discovery Institutional Method is a teaching approach that emphasizes the provision of learning materials with defined objectives under the teachers' guidance. This was swiftly demonstrated by Sola and Ojo (2007) in Anaso (2015), who noted that a student-centered, activity-oriented teaching style allows the instructor to address students' learning by using a problem-solving technique to find answers to instructional ideas. Osisidma (2005) said that one method of instruction for educating and learning about science is the use of student-centered methods like guided inquiry. In a similar vein, Bichi (2006) proposed that female student recruitment in science education is a challenge for science instructors. Use of Guided Discovery Instructional method would have valuable effects on both males and females studying sciences.

### 2.1 Theoretical framework

This study is anchored on Jerome Brunner Theory of discovery approach (1960). The discovery approach was postulated by several psychologists notably Jerome Bruner (1960) and Robert Gagne (1965). But they researchers adopted Bruner. Jerome Bruner is sometimes described as the father of the discovery approach. Discovery method of learning takes place when the individual is involved in using his mental processes to mediate some concepts or principles or generalizations. This implies the mental assimilation by which the individuals grasps a concept or principle resulting from physical and mental activities. Bruner

argues that learning science through discovery enables the child to get four benefits or advantages.

- a) A shift from extrinsic to intrinsic motivation
- b) Increases in intellectual development
- c) Increase in memory retention
- d) It is valuable to student investigative process

He further listed the following two factors as the disadvantages of the approach.

- a) The method is time consuming
- b) It is costly as abundant teaching materials are required

This theory is in line with the topic because guided discovery strategy is similar to discovery method.

### 2.2 Statement of the problem

The main problem of this study is to investigate the effectiveness of Guided Discovery Instructional Method on the academic achievement and retention among NCE I Chemistry students in volumetric analysis in Federal College of Education Obudu. Volumetric analysis is a practical course which deals with the determination of the amount of substance in a given volume of substance say acid and base to actually determine the end point at which a complete neutralization takes place. It is often noted that, most teachers neglect this aspect which carries about 50% of the total mark in NCE I Chemistry exams and therefore leading to poor performance in their practical courses.

According to a study by Ogunboy (2003) and Anaso (2015), there is no discernible difference between male and female students' academic achievement and retention. Because of this, the researchers were motivated to conduct this study in order to determine the reasons behind the students' subpar performance in volumetric analysis.

### 2.3 Research Questions

The four research questions that follow were posed and addressed.

1. What is the average achievement score for students who were taught volumetric analysis through the traditional lecture technique and those who were taught utilizing the guided discovery method?
2. What is the average achievement level of students who were taught volumetric analysis utilizing the guided discovery technique, both male and female?
3. What is the average retention rate for students who receive traditional lecture instruction in volumetric analysis?
4. For both male and female students instructed about volumetric analysis utilizing the

guided discovery method, what is the mean retention score?

## 2.4 Significance of the study

The findings will be useful in the following areas: Chemistry teachers would benefit in such a way that, it would call for improvement in their methodology of teaching and therefore, employ appropriate methods.

Students will gain much knowledge from practical Chemistry, understand it more and develop much more confidence in themselves, improve on good learning skills capable of retention, motivation, stable mind, reduce inquisitiveness, curiosity and self-discovery of knowledge, knowledge acquisition and personal social skills.

Curriculum planners and science educators will benefit from this study by approving and discovering good teaching strategies which would be drawn alongside in the curriculum. It would yield good result feedback and the stakeholders would be impressed with teachers who device good method of teaching and in a right place to ease understanding. Binging innovative means of teaching Chemistry.

## 3. Research Methodology:

The design used to guide this study was an experimental design of pretest and posttest. It was so chosen because, the subject under investigation deals with experimental analysis which is subject to comparison between this sets of students to yield a confirmation of result. The research design can further be illustrated using symbols as represented below:

$$\begin{array}{ccccccc} O_1 & & X_1 & & O_2 & - & E_1 \\ O_3 & & X_2 & & O_4 & - & E_2 \end{array}$$

Where

$O_1$  and  $O_3$  represents pretests

$O_2$  and  $O_4$  represents posttests

$X_1$  Represents guided discovery (experimental treatment)

$X_2$  Represents lecture teaching method (control group)

The population of the study was made up of Chemistry year I students in Federal College of Education, Obudu. This set of students are selected because, the knowledge of volumetric analysis from secondary schools is still fresh and the success of their performances in Chemistry was revealed to be their performance in Chemistry (volumetric analysis). The total population of NCE I Chemistry students in

Federal College of Education Obudu admitted in 2023/3034 academic session was five hundred and twenty (520) including those in Integrated Science combinations.

Purposive sampling procedure was used to ensure that all subjects chosen including male and female are in a similar environment. The total number of NCE I Chemistry students were five hundred and twenty (520) out of which was drawn from the sample which makes it 23% of the sample.

## 3.1 Data collection and results interpretation

Chemistry Volumetric Analysis Test (CVAT), which has a coefficient of reliability of 0.65 using Cronbach Alpha, was the instrument utilized to collect the data. It was then given to specialists in the departments of measurement and evaluation and chemistry to confirm its face validity and contents, respectively. Here, before to the start of the therapy, a pretest was given to the experimental and control groups. to ascertain whether the group's minimal knowledge and proficiency is equivalent. Conversely, the experimental group was given lectures on volumetric computation utilizing guided discovery and word presentations on volumetric analysis without the use of rising guided The discovery Instructional Method.

All these were carried out by the researchers themselves. At the end of every teaching which lasted for three (3) weeks, a post-test was administered to all the groups to determine the level of achievement and retention and the effectiveness of the guided discovery method which was used as a treatment in achieving good learning outcome in volumetric analysis among Chemistry NCE I (one) students. Therefore, the result obtained by the researchers using the instrument was scored using a marking scheme with guided answers organized by the researchers themselves which was used to guide the scoring of the test accordingly. To answer the study questions at the 0.05 level of significance and determine their validity, the data were arranged under the questions and then analyzed using the average standard deviation statistical approach.

## 3.2 Tabulation and analysis

Here, the study questions were addressed using the average standard deviation approach, and the outcome is shown below:

### Research question 1:

What is the average score for achievement of students instructed through volumetric analysis using Assisted Discovery compared to those taught using the traditional lecture method? is the first research question.



**TABLE I:** Mean and standard deviations of post-achievement scores of experimental and control groups.

GROUPS	N	MEANS ( $\bar{x}$ )	S.D
Experimental	60	38.50	21.70
Control	60	43.00	16.62

Table 1 (1) above clearly illustrates the difference in mean achievement scores between students taught with the guided discovery technique (38.50 with a standard variation of 21.70) and those taught with the lecture method (43.00 with an average deviation of 16.62). This finding indicates that students who are taught through guided exploration outperform those who are taught through lecture.

**Research question 2:**

What is the standard deviation performance score of male and female students offered volumetric analysis utilizing the guided discovery approach, according to research question two?

**TABLE II:** Volumetric analysis employing guided discovery: Means and standard deviations on post-achievement scores for male and female students.

GROUPS	N	MEANS ( $\bar{x}$ )	S.D
Experimental	60	40.20	20.00
Control	60	35.51	21.69

The results shows that, the mean achievement, scores of males was 40.20 and the females is 38.51 with standard deviation of 20.00 and 21.69 respectively. Therefore, this result shows that there is always a disparity to show that male and female retention and performance is always different though the level of success on the above variables mentioned is better than using lecture method.

**Research question three (3)**

Research question three states that; what is the mean retention score of students taught volumetric analysis' using conventional lecture method.

**TABLE III:** It is the mean scores and standard deviation of post scores of both experimental and control groups.

GROUPS	N	MEANS ( $\bar{x}$ )	S.D
Experimental	60	42.22	17.00
Control	60	40.21	20.01

From table 3 the result shows that experimental group taught with guided discover method had a mean posttest scores 42.22 with in standard deviation of 17.00 while those in the control group taught with lecture method had 40.21 mean scores with standard deviation 29.01 in their posttest result. The group of

experimental retained concepts learned more than, those in the control group.

**Research question four (4)**

The fourth research question asks what the average retention scores are for both male and female students who are taught volumetric analysis through the guided discovery approach.

**TABLE IV:** Mean scores retention of male and female students taught volumetric analysis using guided discovery method.

GROUPS	N	MEANS ( $\bar{x}$ )	S.D
Experimental	60	42.22	17.00
Control	60	40.21	20.01

**4. Results and Discussion:**

The results, which are displayed in Table 1 above, demonstrate that students who were taught volumetric analysis through the guided discovery method outperformed those who were taught through the conventional lecture method. This is consistent with Osisioma's (2005) assertion that guided inquiry, or other student-centered methods, is a technique for providing science education and that using them in this context is a way for students to achieve academically.

In table two (2) the result shows that, the methodology or strategy favors both male and female students. Though male students seems to be more active than female students. This findings is in tandem with a study carried out by Mohammad (2007) on the issue of gender achievement in science. He relate it to a numbers of factors such as sex role, educational background of parents, peer group influence.

In table three (3) shows that, when students are taught with a guided instruction it stimulates their retention in any academic task such as volumetric analysis using guided discovery method approach by teachers. This supported the findings of Solla and Ojo's (2007) study, which defined a guided-discovery technique as an activity-based, student-centered teaching style in which the instructor guides students in solving problems to find the answers to lesson topics. Therefore, using conventional method in teaching volumetric analysis is not quite appropriate to the students as it is more of teachers-centered and not students as it reduces the level of retention of concepts by the students.

Table four (4) proves that the retention in both sexes is impressive confirming to what Hebden (2005) who in his study reported that gender is not the main factor in student's attitude towards Chemistry learning, when teaching is effective. Alarsete (2007) suggests the need to sustain student positive attitude towards

Chemistry by adopting a teaching strategy that makes understanding of facts easier. Thus this also affirmed what Usman (2010), said that if males and females are given equal opportunity they will perform equally well.

## 5. Conclusion and Recommendation:

This study has shown clearly that the use of guided discovery method of instruction facilitate academic achievement and retention ability of students in volumetric analysis in Chemistry. This process is gender friendly as both sexes perform well when exposed to this method of learning. Thus, this strategy is of great benefit to them because, the level of retention ability increases and dispose them to much active learning. Consequent upon that guided discovery method could have the potential of improving students' academic achievement in volumetric analysis in Chemistry (practical Chemistry).

### Findings:

It was seen that guided discovery method is the best method to use to teach practical Chemistry because it is an activity-based approach on both teachers and students:

1. It help the students to learn faster and develop self-discovery learning approach
2. Due to the actual activity based on both teachers and students gender influence is not seen to be enough factor for students to perform differently as far as they are taught very well.
3. Conventional lecture method is quite not practical oriented since its application is teacher's-centered making concepts appear abstract.

### 5.1 Recommendations:

The following recommendations were made.

- 1) Guided discovery method should be applied by Nigerian teachers to teach Chemistry practical topics to facilitate achievement and retention in Chemistry.
- 2) Higher institutions like Colleges of Education as well as Polytechnics and Universities should infuse this method into their syllabus or course break down methodologies.
- 3) Improve teachers, competency and awareness in writing, this method facilitate learning and retention ability of the students in science base learning.
- 4) Curriculum planners should quickly make this method one of the major teaching strategies used in teaching practical Chemistry to encourage achievement and retention.

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