EFFECTS OF GUIDED DISCOVERY AND LECTURE TEACHING METHODS ON STUDENTS' ACADEMIC ACHIEVEMENT IN SENIOR SECONDARY SCHOOL MATHEMATICS IN DELTA NORTH SENATORIAL DISTRICT OF DELTA STATE

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DELTA STATE UNIVERSITY, ABRAKA

MARCH, 2017

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DEDICATION

This work is dedicated to my lovely husband Deacon Moses Ofuonyebuzor for standing by me throughout this work.

CERTIFICATION

We the undersigned certify that this research was carried out by Ofuonyebuzor, Patience Anthoinette in the Department of Curriculum and Integrated Science, Delta State University Abraka, Delta State.

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Prof. Emperor Kpangban Date
(Supervisor)

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Prof. O.P. Ajaja Date
(Head of Department)

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Prof. E.P. Oghuvbu Date
(Dean of Education)

DECLARATION

I declare that this is an original work that was carried out by me in the Department of Curriculum and Integrated Science, Delta State University, Abraka Delta State.

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Ofuonyebuzor, Patience Anthoinette Date

(Student)

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ABSTRACT

This study investigated the effect of guided discovery and lecture teaching methods on students' academic achievement in senior school mathematics in Delta North Senatorial District. The design of the study was a pre-test, post-test control group of quasi-experimental type. The population of the study consist of 6,453 of SS I students. A purposive random sampling method was used in selecting the local government areas, schools and classes. The sample size had a total of 163 males and 157 females. Mathematics Achievement Test (MAT) was used for data collection. The reliability of the instrument was 0.65 obtained using Kudar-Richardson formula 20. The research questions were analyzed using mean and standard deviation while the hypotheses were tested using t-test at 0.05 level of significance. The findings of this study revealed that those taught with guided discovery teaching method performed better than those taught with lecture teaching method. Students in urban areas performed better than those in the rural areas taught with guided discovery and lecture teaching method. Based on these findings, it is recommended that guided discovery teaching method should be practiced intensively by Mathematics teachers since the method proved effective in enhancing students' academic achievement; and teachers should be patient in using the guided discovery teaching method because it improves students' academic achievement. Moreover, Mathematics teachers should make the teaching-learning of mathematics interactive and activity–based for students using guided discovery method so that all students could gain irrespective of the ability levels of the students.

CHAPTER ONE
INTRODUCTION

Background to the study

Education is an indispensable tools for the progress and sustainable development of any nation. According to Akilaiya in Ekwue and Umukoro (2007) education is the bedrock of civilization and instrument of change, useful living, social progress and meaningful development. The survival of any individual and the society depends largely on the type and quality of education acquired. On a daily basis, man encounters new problems and redefines methods to tackle them. As such, there is a continuous search for solutions to problems and also frameworks for solving anticipated tasks are designed. Science and mathematics involve acquisition of knowledge, while technology is the application of knowledge within the context of cultural and societal values (Oluchukwu, 2002).

The belief of teachers and students about what mathematics is frequently affects what mathematics is and the achievement that would be made. If students believe that mathematics is a collection of rules, for example, this would affect their learning of the subject by their search for rules to memory. On the other hand, if teachers think of mathematics as a rigid formal system, they might remain unaware of alternative concepts or ways of perceiving mathematical ideas. Mathematics is the language without which science, commerce, industry, the internet and the entire global economic infrastructure are stock dumb. Mathematics is regarded as pillar of almost all the streams in academics given its importance in tertiary education and most careers. It is not only beneficial but also essential. Hence, Mathematics is not only a language and a subject in itself, but it is also critical in fostering logical and rigorous thinking; as such its influence is immense. Aminu (1990) opined that Mathematics is not only the language of sciences, but essential nutrient for thought, logical reasoning and progress. Mathematics liberates the mind and also gives individuals an assessment of the intellectual abilities by pointing towards direction of improvement. He concluded that mathematics is the basis of all sciences and technology whose applications cut across all areas of human knowledge.

The essence of mathematics therefore lies in its beauty and its intellectual challenge. Both scientific breakthrough and technological development are facilitated by the precise language of Mathematics. This implies that there exists a strong link between progress in

Mathematics and technological advancement. Thus, every man requires a certain amount of competence in basic topics in mathematics for the purpose of handling money, prosecuting daily businesses, interpreting mathematical graphs and charts as well as thinking logically (Bandura, 1997). Inspite of all these, the subject is still seen as a difficult one and has generated phobia among learners. There is a consensus of opinion about the fallen standard of education in Nigeria (Adebule, 2004). Parents and government are in total agreement that their huge investment in education is not yielding the desired result. Teachers also complain of students' poor achievement in both internal and external examinations. The annual Senior Secondary Certificate Examination results (SSCE) conducted by the West African Examinations Council (WAEC) justified the problematic nature and general of poor secondary school students' achievement in the subject from 2004 – 2010 (Appendix I). Fajemidagba (1999) observed that the problems of Mathematics learning is the poor methods teachers adopt in the teaching of Mathematics in schools. Nnaobi (2007) and Orlich, Harder, Callaham, Trevisan and Brown (2010) noted that there is no best method of teaching but that effective Mathematics teaching should be activity-oriented rather than textbook or lecture – dominated which seems to characterize the Nigerian schools. The lecture method is characteristic of the traditional teaching in which the teacher does it all alone. Lecture method of teaching enhances quick content coverage and its effectiveness depends on the verbal skills of the teacher (Ezenweani, 2002). He ascribed the lecture method to the least dedicated teacher whose main interest is in content coverage and not content mastery. For activity-oriented and effective Mathematics teaching in the secondary schools, Mathematics teachers should adopt the use of innovative discovery method (Ezenweani, 2002). The guided – discovery method is a student – centred, activity – oriented teaching method in which the teacher guides the students through problem-solving approach to discover answers to instructional topic at hand (Akinsete, 2006). Guided discovery method of teaching aids conceptualization, memory and helps to develop students understanding of Mathematics.

It is widely agreed upon that mathematics is a valuable subject because it disciplines the mind and thereby enables the individual to deal more successfully with problems outside mathematics that the individual would not have been able to do without the knowledge of mathematics. By solving exercises, students learn to concentrate, draw deductions, think clearly and express themselves precisely and accurately. From the above, mathematics could therefore be defined as the science that seeks to improve clear logical, precise and exact thinking in man.

The importance and usefulness of mathematics cannot be over-emphasized, since it is necessary in day-to-day living. In line with this, Obi (1998) stated that "the foundation of science and technology is mathematics". If the foundation is weak or nor existent, the super-structural development and technological know-how would be weak. The issue remains that failure in mathematics may continue to affect the number of intakes into science departments in institutions of higher learning. This may lead to technological under-development of Nigeria as a nation. In the Nigeria context, the educational system is structured in such a way that emphasis is laid in Science, Technology and Mathematics (STM) Education. As such, a good pass grade in mathematics at junior secondary school level (JSS) is a basis for good performance at the senior secondary school level mathematics. The implication is that the mathematics teacher should help to motivate the students in order to develop positive attitude in the subject. Once a child developments interest in a particular subject, he is bound to perform well in it.

Students' academic achievement in mathematics depends on a number of factors, including teaching methods. Teaching method is a process, a course of action or a method of operation which varies according to circumstances. Teaching methods are the types of activities the teacher and students embark on together in the teaching-learning process. In education there exist many teaching methods. These include: lecture, discussion, questioning approach, problem solving approach, guided discovery and so on. In the teaching of science, mathematics included, discussion, questioning, guided discovery and problem solving approaches are encouraged for use in the teaching learning process. The reason is that these methods allow students' participation, where interest is stimulated and their perception broadened. Unfortunately, most mathematics teachers do not apply these teaching methods. Some mathematics teachers write the questions on the chalkboard and solve them with little or no explanation and expect the students to understand. Some of the teachers do not bother to give the history of the topic they teach and so students do not know where they are coming from or where they are to. Some teachers do not seem to realize that the interest which students show in a science subject and the mastery they demonstrate on the completion of a course of study depend to a large extent on the teaching method employed (Oriaifo, 1986).

In view of students' poor response to mathematics in most schools and the mass failure in the subject at the Senior Secondary Certificate Examination (SSCE), many people have

continued to wonder why the situation is so. Ekwo (1986) observed that students' performance in science, particularly mathematics at the secondary levels in both internal and external examinations is very poor and discouraging. To buttress, the emphasis on Science, Technology and Mathematics (STM), the National Policy on Education (FRN, 2004) stated that STM should aim:

1. to inculcate in the child the spirit of enquiry and creativity through exploration of nature and the local environment in pre-primary education;
2. to lay a sound basis for scientific and reflective thinking in primary education; and
3. to equip students to live effectively in our modern age of science and technology in secondary education.

As a matter of fact, these objectives are a major concern to educators and investigations are being made in order to attain them. Some studies have reviewed the problems affecting the teaching of science, technology and mathematics. Others have looked at teachers' related variables while others considered environmental and student's variables. Obioha (1987) stated that though the curriculum of Science, Technology and Mathematics (STM) has improved, yet the younger generation of students do not want to study science. The consequences are low enrolment and poor performance in examination as observed in the West African Examinations Council (WAEC) SSCE results from 2004-2010 (Appendix 1). Eniayeju (1991) traced the problems to poor foundation in Mathematics. It is not strange, therefore, to observe the involvement of mathematics teachers, educationists and other interested associations like Mathematics Association of Nigeria (MAN) and the Science Teachers Association of Nigeria (STAN) in finding solutions to the problems of teaching and learning of mathematics in secondary schools. In line with this, books have been written by the Mathematics Association of Nigeria (MAN) to reflect the new curriculum and occasionally too, in-service training, seminar and workshops were organized for mathematics teachers. In order to enhance students' interest and performance in mathematics, the Mathematics Association of Nigeria (MAN) organizes mathematics quiz competitions for students in secondary schools every session and prizes are given to deserving students. The Cowbell Nigeria PLC also organizes a national secondary school mathematics competition were prizes are also given to deserving students.

Achievement in the teaching and learning process has to do with attainment of set objectives of instruction (Nbina & Obomanu, 2011). It is a reflection of the nature of learning of the

intellectual tasks and the realization of educational objectives (Idehen, 1997). Attainment of high level of academic achievement is what every parent or guardian desires for his/her child or ward. The teacher desires the same high achievement for the students. Schools and teachers are generally graded quantitatively by the achievement of their product. Parents, students and teachers want to associate themselves with schools that have records of high level of academic achievement. Since achievement plays such an important role in the lives and activities of students, it is therefore, necessary to investigate issues that surround it. Interested bodies like the Mathematics Association of Nigeria (MAN) and the Science Teachers Association of Nigeria (STAN) in finding solutions to the problems of teaching and learning of Mathematics in secondary schools, have written books, organized workshops and seminar and quiz competitions for students with awards attached to enhance students' academic achievement in Mathematics. Yet, achievement in mathematics both in internal and external examinations continues to be poor.

Theoretical solutions to this problem have been offered by teachers, researchers and mathematics educators. Only few empirical investigations have attempted to identify problems such as study behaviour and academic performance as a factor of gender, parents' education, types of school and level of academic achievement (Ozegbe, 1990 & Umaru, 1994). It becomes necessary to initiate a study that will attempt at identifying some factors necessary to enhance students' interest and achievement in mathematics.

This study, therefore seeks to investigate the effect of guided discovery and lecture teaching methods on students' academic achievement in senior school mathematics in Delta North senatorial district.

Statement of the problem

Mathematics is the basis of all sciences and technology with applications cutting across all areas of human knowledge. Inspite of its importance, there has been poor achievement in the subject both in internal and external examinations. The annual Senior Secondary Certificate Examination results (SSCE) releases by the West African Examinations Council (WAEC) justifies the notion that there is poor academic achievement of students in the subject. In 2004, 1,035,266 students enrolled for the examination out of which 33.97% of the number of students that enrolled had credit while 34.47% failed. In 2005, 1,080,133 enrolled, 34.41% failed as

against 38.20 that had credit. In 2006, 1,035,266 enrolled, 24.95% failed while 41.12% had credit. In 2007, 1,170,523 enrolled for the examination. 46.76% had credit while 24.24% failed the examination. Having a solid background in Mathematics helps students develop sophisticated perspectives. However, educators have relied on many sources of information and focused on various factors that might affect students' mathematical achievements. A central and persisting issue is how to provide instructional environments, conditions, methods and solutions that achieve learning goals for students with different skill and ability levels. A question emerges; does teaching method affects students' academic achievement in Mathematics? Can guided discovery teaching method yield a better academic achievement than the lecture teaching method in the teaching and learning of mathematics?

Thus, the study seeks to proffer solution to the question. What is the effect of guided discovery and lecture teaching methods on students' academic achievement in senior school mathematics in Delta North senatorial district of Delta State?

Research questions

The following research questions were raised to guide the study:

1. Is there any difference in students' achievement in mathematics between students taught using the guide discovery teaching method and those taught with the lecture teaching method?
2. Is there any difference in students' achievement in mathematics between male and female students when taught with the guided discovery teaching method?
3. Is there any difference between male and female students' achievement in mathematics taught with lecture teaching method?
4. Is there any difference in students' achievement in mathematics between students in rural schools and students in urban schools, taught with guided discovery teaching method?
5. Is there any difference between urban and rural students' achievement in mathematics taught with lecture method of teaching?

Research hypotheses

The following null hypotheses were formulated for testing at .05 level of significance.

$Ho_{1:}$ There is no significant difference in students' mean achievement test score in mathematics between students taught using the guided discovery teaching method and those taught using the lecture teaching method.

$Ho_{2:}$ There is no significant difference in students' mean achievement test score in mathematics between male and female students taught with the guided discovery teaching method.

$Ho_{3:}$ There is no significant difference between male and female students' mean achievement test score in mathematics taught with lecture method of teaching.

$Ho_{4:}$ There is no significant difference in students' mean achievement test score in mathematics in rural schools and those in urban schools, taught with guided discovery teaching method.

$Ho_{5:}$ There is no significant difference between urban and rural students' mean achievement test score in mathematics taught with lecture method of teaching.

Purpose of the study

The general purpose of this study is to examine the effect of guided discovery and lecture teaching methods on students' academic achievement in mathematics.

Specifically, the study seeks to:

1. ascertain the difference in students' achievement using the guided discovery teaching method and those taught with the lecture teaching method;
2. examine the difference in students' achievement in mathematics between male and female students taught with the guided discovery teaching method;
3. compare the difference between male and female students' achievement in mathematics taught with lecture method of teaching;

4. ascertain the difference in students' achievement in mathematics between students in rural schools and those in urban schools, taught with guided discovery teaching method;
5. compare the difference between urban and rural students' achievement in mathematics taught with the lecture method of teaching.

Significance of the study

This study would be significant to the teachers, government and future academic researcher.

The result of the study would help teachers to identify effective ways of teaching Mathematics at the secondary school level. Hence, yielding better academic achievement in Mathematics on the part of the students.

The study would be useful to government in the search for educational policy variable(s) which would be used to improve the achievement levels of students in planning Mathematics curriculum.

The study would contribute to the data bank for future researchers in Mathematics education to gain from expansion of literature based on the findings that would emanate from the study.

Scope and delimitation of the study

This study is designed for the purpose of determining the effects of guided discovery and lecture teaching methods on students' academic achievement in senior secondary school Mathematics in Delta North senatorial district. The study is intended to cover public secondary schools. Delta North senatorial district is one of the senatorial district in the state. It is made up of nine local government areas amongst which are: Aniocha North, Aniocha South, Ika North East, Ika South, Ndokwa East, Ndokwa West, Oshimili North, Oshimili South and Ukwuani local government areas.

Limitation of the study

The study was faced with some weaknesses. Training of research assistants was bedeviled with inadequate logistics. Visitation to sampled school to get the cooperation of

teacher was a difficult task. The data collected for generalization of finding were generated from SS 1 students which may not be justifiable with SS 3 students.

Operational definition of terms

For the purpose of this study, operational definitions were given to the following terms:

Teaching Methods: This refers to the type of activities that the teacher, together with the students embark on in the teaching-learning process to motivate students and enhance learning.

Guided Discovery: This is a teaching method by which students are guided by the teacher to discover knowledge for themselves. It is a teaching process where the teacher facilitates knowledge on concept(s) to be learnt by providing the materials and encouragement needed and structuring the environment in such a way that through the interaction of the student with the things provided by the teacher based on the student's conceptual knowledge, knowledge is discovered.

Lecture Method: This is a teaching method where the teacher does everything. The teacher discovers knowledge about the concept he wants to teach and then passes it on to the students who are seen to be passive learners. It is a teaching method where students study the information passed onto them by the teacher in preparation for the evaluation of the concept taught.

Academic Achievement: This refers to the scores obtained by the students in the pretest and posttest after the Mathematics Achievement Test (MAT) was administered.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

This chapter focused on the review of literature related to this study. The chapter examined the theoretical and empirical review under the following sub-headings:

Conceptual framework of the Study
The Concept of Teaching and Teaching Methods
Guided Discovery Teaching Method
Effect of Guided Discovery Teaching Method on Students' Academic Achievement in Mathematics
Lecture Teaching Method
Effect of Lecture Teaching Method on Students' Academic Achievement in Mathematics
Review of Some Empirical Studies on Guided Discovery
Review of Some Empirical Studies Lecture Teaching Methods
The Concept of Academic Achievement in Mathematics
Gender and Academic Achievement in Mathematics
School Location and Academic Achievement in Mathematics
Appraisal of the Review

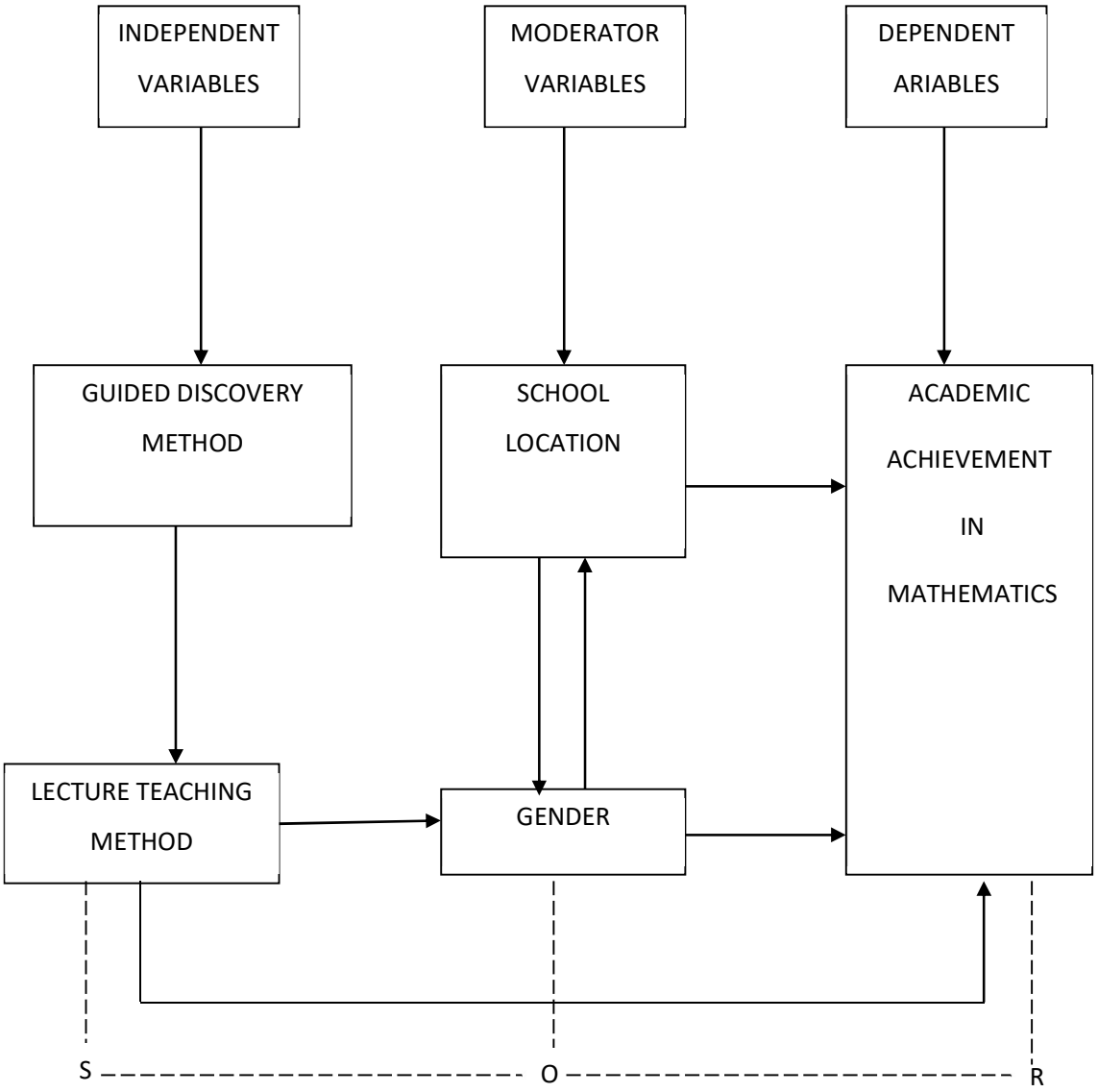
Conceptual framework of the study

There are three major components of education: Input, process and output. Olaoye (2004) buttressing this classification, made it known that an educational system has a set of inputs, which are subject to processes designed to attain outputs. The outputs are designed to satisfy the systems' objectives.

The input variables in this study relates to the independent variables of teaching methods. The input variables play a role in the teaching learning process. The variables that pertain to the interactions between the teacher, students and resource provision in the school (instructional materials, classroom, school environment and so on), are referred to as process variables. The output or product variable deals with the extent of achievement which occur as a result of the process in the interaction between the teacher and students with the instructional

materials in the classroom. Olaoye (2004) concluded that the input variables, process variables and their interactions affect significantly the product or output variables.

The study was based on Hull's (1943) theory of behavioural paradigm of stimulus organism response (S – O – R) equation. Hull (1943) came up with a theory on principles of learning by conditioning animals to certain behaviour characteristic. Hull expressed his model in biological terms: organism suffers deprivation; deprivation creates needs; needs activate drives; drives activate behaviour; behaviour is goal directed; achieving the goal has survival value. Relating this to the study under review, the organism which in this case is the student in a given school location was exposed to the stimulus of guided discovery and lecture teaching methods. The stimulus was necessary due to the deprivation (knowledge deficiency) in the organism. The stimulus provided, creates a need in the organism. When the needs are positively responded to by the organism, through the desired objectives stipulated to be met as occasioned by the teacher, it causes a change in behavior on the organism which has a survival value termed achievement. This is illustrated in the model in figure 2.



Key

S = Stimulus

O = Organismic

R = Respond

Fig 2: Conceptual Framework of the Study

Source: Partly adapted from Hull (1943)

The study investigated the effect of the independent variables on the dependent variable. As represented in the model of study the independent variables are guided discovery and lecture teaching methods. They were referred to as independent variables because they were the variables that were manipulated to cause changes in the dependent variable which is the outcome. These independent variables in the behaviour paradigm stand for the stimulus (S) dimension. There are certain factors that were presumed to mediate between this stimulus and the outcome (responses). These were referred to as intervening or moderator variable(s) as shown in the model of the study. These variables in behavioural paradigm stands for organism variable (O). These variables affect the response mechanism of the organism. The dependent variable stands for the outcome (responses) as a result of the effect of the stimulus on the organism. The way the organism responds to the stimulus results in either positive or negative response.

The concept of teaching and teaching methods

To teach means "to show how to do". Teaching is a systematic presentation of facts and techniques to learners. It is a process of guidance by which the learner is able to grasp ideas and facts and develop skills. It is the process of transmitting knowledge and skills.

Teaching is showing how, informing, explaining, directing, clarifying and evaluating. Teaching is guidance of learning activities. The activities may be overt or covert, mental or physical (Otu, 2006).

Oyegwe (1998) opined that teaching is the act of imparting information (knowledge) to learners. Teaching constitutes the organization of activities that would lead to the realization of the objectives of the curriculum.

Teaching could be viewed from four phases:

i. Curriculum planning phase;
ii. Instructing phase;
iii. Measuring phase;
iv. Evaluation phase.

At the curriculum planning phase, the teacher should formulate behavioural objectives appropriate for the selected content materials to achieve the stated objectives. The instructing

phase is one of which the teacher creates a conducive atmosphere for learning, uses and modifies known instructional strategies and tactics within the classroom to bring the content materials within the levels of the students. The measuring phase is the phase of selecting or creating measurement device, and analyzing measurement data. The evaluating phase deals with evaluating the appropriateness of objectives, the effectiveness of instruction and validity and reliability of devices that would be used to measure learning (opute-Imala, 2006). Students come to class with different learning abilities and at different levels of understanding. Therefore, the teacher's instruction should be well directed, purposeful and audible to the students and free from all disturbing mesmerism. In teaching, there exist interactions between:

i. Teacher and students;
ii. Teacher and content;
iii. Content and students, until the students grasp what is being taught by the teacher. The way students understand what is taught could make people categorize teachers using the sentences:

The mediocre teacher tells;

The good teacher informs;

The superior teacher demonstrates;

The great teacher inspires (Williams, 2005; Purkey & Novak, 2009)

A teaching method comprises principles and methods used in instruction. Methods are teachers' style or ways or procedures of presenting information, knowledge and values and so on to learners to achieve desired instructional objective. (Opute-Imala & Idailu, 2000). A teaching method is a process, a course of action or a method of operation which varies according to circumstance (Umar, 2008). Oyegwe (1998) also holds the view that teaching methods are the types of activities pursued by teachers and students together in the teaching-learning process.

There are as many teaching methods as there are teachers. Any method that is adequately employed by a teacher has the potential of promoting learning, curiosity, self-reliance, initiative and sharpening mental activities in the learners (Opute-Imala & Idialu, 2000). According to Orlich, Harder, Callahan, Trevisan and Brown (2010) there is no one

"right" way to teach anything or anyone. Since teaching is a decision making activity, knowledge and artistry, then there ought to be a variety of means of accomplishing any instructional objectives. The choice of teaching method(s) to be used, therefore, depends largely on the information or skill that is to be taught, and it may also be influenced by the aptitude and enthusiasm of the students. The method of approach is very vital in any teaching learning situation. Since learners may like or dislike a subject as a result of teachers' presentation of the subject matter, teachers should device different ways of facilitating the process of leaning.

There are various method of teaching and a teacher worth his/her salt should device different ways of facilitating the process of learning (Oyegwe, 1998 and Ezenwani, 2002). An effective teacher uses a wide variety of teaching methods and techniques. The range of instructional strategies that one can use in the classroom is limitless (Tate, 2003). Teaching methods are usually named after the dominant activities employed in the course of the lesson. Some of the methods are lecture, discussion, demonstration, guided discovery, and question and answer. Amongst these methods guided discovery and lecture are the focus of this study.

Guided discovery teaching method

Guided discovery was developed by Charles E. Wates at the centre for Guided Design, West Virginia University. Quite a number of early and modern researchers on teaching methods have recommended the guided discovery method as very suitable. According to Allen (2002) guided discovery is characterized by convergent thinking. The instructor devises a series of statements or questions that guide the learners, step by step, making a series of discoveries that leads to a single predetermined goal. In other words the instructor initiates a stimulus and the learner reacts by engaging in active inquiry thereby discovering the appropriate responses. Furthermore, the guided discovery method of teaching uses the fact that a student's own experience is the basis of real learning as it puts the student into the position of a discoverer who by the use of tools and information available, discovers knowledge and draws conclusion for himself/herself.

The guided discovery approach is regarded as an innovation to the much talked about student centred learning process. For learning to be effective, students must play active role in it. Ezenweani (2002) emphasized that instruction should be to enable students to participate in the process of knowledge not in its product. He asserted that "knowledge is a process not a

product", and that a student must make an active response for learning to occur. According to him, the student must be guided to develop interest in the learning process. What has to be taught, when and how to teach it are all curriculum questions that must be carefully answered for the purpose of guiding and stimulating the interest of the student. He recommended the guided discovery method for the teaching of the sciences at the senior secondary schools.

With the introduction of the 6-3-3-4 system of education, there has been a revolution in science teaching-learning process in our secondary schools. The Federal Republic of Nigeria (FRN) (2004) states that the current system of education favours "self-learning", "development of skills in certain basic fields", and "people who can apply their scientific knowledge to the improvement and solution of environmental problems" (CESA, 1985). In line with this development, there has been increasing emphasis on teaching-learning methods which are hitherto neglected. In recent times shifts have occurred from:

i. Teaching demonstration to student experimentation
ii. Memorization of facts to understanding of facts
iii. Learning solutions to problem solving
iv. Teaching demonstration to teacher direction.

Science teachers and curriculum designers over the years are engaged in designing and reviewing secondary school science curriculum, in an attempt to make students learn science through "hand-on" experiences. This indicates a shift from the lecture method to the discovery method where students are encouraged to find solutions to problems by themselves through proposing their own methods of investigation; making their own observation, and drawing their own conclusions (Marzano, 2001; Kpangban & Inomiesa, 2001). They observed that active students' participation through experimentations and discussion with the teacher playing the role of a leader is encouraged in the curricula. They said that student activity-oriented nature of project provides a unique chance of student "doing" mathematics instead of "reading" mathematics at school.

Abdullahi (2007) opined that guided discovery method is a student centred, activity-oriented teaching method in which the teacher guides the student through problem-solving approach to discover answers to instructional topics at hand. Akinsete (2006) recommending the use of this teaching method noted that it encourages a student to solve problems by seeking

and asking questions so as to gather information. He also noted that this method of teaching aids creative ability in a student as he/she participates in the teaching-learning process, aids conceptualization, memory and helps to develop students understanding and communicative skills.

Agreeing with the above researchers, Choike (2000) opined that learning by guided discovery allows more room for individual experience and involvement during study. Guided discovery learning is self-sequenced, goal-directed and the pace is self – determined. Buttressing further on guided discovery method, Orlich, Harder, Callanhan, Treveisan and Brown (2010) said that guided discovery method is a technique that incorporates many other methods. It can start with demonstration or lecture method from where the problem arises, through either a project or an approach where findings by individuals or groups are shared. They noted that this teaching-learning method produces superior results in terms of students' ability to apply the principles that he/she had learned in one problem situation to a similar situation.

Mathematics teachers are therefore encouraged to take advantage of the great opportunity to arouse and challenge the curiosity of students by offering them problems within their cognitive levels, and challenge them to employ previous concepts in ways that are new and different to them. The ultimate goal of this kind of instruction, that goal for which all mathematics teachers should aim, is the development of students' independent thought (Choike, 2000; Marzano, 2001; Kpangban and Inomiesa, 2001; Orlich, Harder Callanhan, Treveisan and Brown, 2010).

Effect of guided discovery teaching method on students' academic achievement in mathematics

According to Choike (2000), by seeking and asking questions, students gather information and discover knowledge by themselves. Knowledge discovered by oneself builds in the learner high intellectual potency level, increases expectancy level and encourages high level thinking. This leads to academic achievement in mathematics in the student (Oyegwe, 1998; Opute-Imala & Idialu, 2001). Guided discovery method creates creative ability in students (Allen, 2002). Guided discovery method enables student transfer what he learnt in one concept to other concepts, thereby developing the student independent thought (Marzano, 2001). This method of teaching is slow, time-consuming, has high financial implication and is

non-effective for a large class, as the teacher is not able to cover the scheme. Thus, students may not have knowledge of all they are expected to know in the scheme and this may affect their achievement in a way.

Lecture teaching method

The lecture is an oral method of getting across knowledge, concepts, skills, values, attitude, facts and information. It is presumed to be the oldest method of instruction and is synonymous with "chalk and talk". Whether the lecture method is an approved method of teaching science in our secondary schools is open to debate. The fact is that it is being used every day in the teaching of sciences in our secondary schools.

Oyegwe (1998), Opute-Imala and Idialu, 2000 and Massay (2000) noted that the lecture method is characteristic of the traditional teaching in which the teacher does it all alone. They said that the student should be regarded not as an empty mind into which the teacher is to pour his accumulated wisdom but as an associate with his/her learners in the acquisition of knowledge. They see the lecture method as not very ideal in attaining high cognitive objectives or for making significant contribution to the changing attitude and social living. Its effectiveness is dependent on the verbal skills of the teacher and declines when the teacher lacks some of these essential attitudes. They however, in recommending this method said "A teacher who uses the lecture method should try to clarify the terms he/she uses and explains new words as carefully as if he/she were given an assignment. Most importantly, it should be recognized that the lecture is a function of the learning climate and as such it can be successful only when the learning considerations are ideal. Furthermore, they said there is need for the teacher to possess a captivating personality and high quality professional attributes. He/she must be friendly and competent in teaching. He/she must also possess a good voice, clear and good command of English language.

Ezenweani (2002) observed that the lecture method is good for the following reasons:

1. Quick coverage of the syllabus/scheme;
2. Introduction of a new topic;
3. Summarizing a lesson.

He however criticized the lecture method of teaching science and ascribed it to the least dedicated teacher whose main interest is in content coverage and not content mastery. He recommended the use of discussion, demonstration and guided discovery as better alternatives to lecture method.

According to Hillier (2005) "lecture" as a teaching method makes it easier for information from spoken communication from reading, as it makes students focus attention and remember what is said than when students are required to work alone. He said that lecture notes recognize the power of the spoken word. A student's own written summary of one important factor is that lecture note-taking has the advantage of encouraging deep processing forms of memorizing, by imposing a need for students to understand, abbreviate and restructure it (Young, Klem & Murphy, 2003).

In line with this, Orlich et al (2010) said that it is the taking of lecture notes which is the key factor in converting the potentially passive experience of listening to a lecture into the active experience of learning in a lecture. According to them lectures retain a major educational role because they exploit evolved aspects of human nature to make learning easier and more effective.

Effect of lecture teaching method on students' academic achievement in mathematics

The lecture method has a few advantages that have kept it as the standard approach to teaching for so long. The method is teacher control/led and highly consistent when it comes to what kind of information is delivered, how it is delivered and the large quantity of materials to be covered. The lecture method makes the learning process effortless on the part of the students, who need only pay attention during class and takes note. Because so little input is required from students, it is the most clear, straightforward, and uncomplicated way to expose students to large quantities of information, thus covering a large percentage of the scheme quickly (Ezenweani, 2002; Hillier, 2005; Orlich et al, 2010).

The effectiveness of the lecture method depends on the verbal skill of the teacher. This implies that students cannot grow academically above the knowledge of the teacher. The lecture method makes students passive learners. As a result of not participating in the teaching-learning process, the exercise may become worthless to the students to the point of being bored because they have no opportunity to learn how the subject applies to them on a personal level and

because knowledge learnt in one concept cannot be applied to another concept due to lack of personal experience and hence their achievement is affected (Oyegwe, 1998; Massay, 2000; Opute-Imala and Idialu, 2001).

Review of some empirical studies on guided discovery method

There is a consensus of opinion about the fallen standard of education in Nigeria (Adebule, 2004). Parents and government are in agreement that their huge investment on education is not yielding the desired dividend. Teachers also complain of students' low achievement in both internal and external examinations. The annual release of Senior Secondary Certificate Examination (SSCE) result conducted by West African Examinations Council (WAEC) justified the problematic nature and generalization of poor secondary school students' achievement in different school subjects. Students' poor achievement in mathematics have been link by some researchers to teaching methods. Ezenweani (2002) posits that quest for continuous research has brought many methods of teaching mathematics. Oraifo in Unuero (2008) using the Solomon four-Group Design of two experimental and two control groups evaluated an Individualized Instructional Package (INPAC) by comparing it with the traditional lecture methods using a sample of 280 subjects randomly selected secondary class four students from eight coeducational schools in Edo/Delta States and the result showed that students have a better retention capacity and better achievement with the individualized method than with the lecture method.

Suleiman (2010) investigated learning by lecture and guided discovery methods at four age levels. Eighty students were given a special prepard course of instruction in primary numbers. The students were randomly assigned so that equal numbers learnt by lecture and discover method. Subjects were tested for arithmetic ability, and a follow up test in binary number was administered. An attitude questionnaire was completed by each student to elicit learning mode preference. The result showed that the, guided discovery group learnt significantly better with a better academic achievement than the lecture group.

However, Salman (1998) studied the effect of guided discovery and expository teaching methods on the mathematics achievement of analytic and non-analytic dimensions in cognitive styles. He found no significant effect of teaching methods. According to him, the students'

cognitive style is a more important determinant of student academic achievement than the teaching method employed.

A study carried out by Adekunle (2015) on the effects of guided discovery and think-pair-share strategies on secondary school students' achievement in Chemistry, revealed that students taught with guided discovery and think-pair-share strategies obtained significantly higher posttest mean scores than those in the lecture strategy, $F(4, 223) = 51.66$, $p < .05$. The use of guided discovery and think-pair-share strategies had great potential for improving achievement in chemistry and science learning generally.

In the same vain, a study carried out by Nbina (2013) on the relative effectiveness of guided discovery and demonstration teaching methods on achievement of chemistry students of different levels of scientific literacy revealed that the guided discovery method was significantly superior to the demonstration teaching method in enhancing cognitive achievement in chemistry for all levels of scientific literacy students. For the guided discovery and demonstration teaching methods, the higher the scientific literacy levels, the higher the achievement of students in chemistry. It was recommended that the government should encourage science teachers to use guided discovery method by providing needed conducive environment for teaching and learning with adequate instructional materials; in service training of science teachers on how to use guided discovery is needed since most of such innovative teaching method enhances students' academic achievement; and science teachers should no longer be contented with teaching for acquisition of knowledge alone but should also teach for inculcation of scientific literacy.

Ugwuadu (2010) in a study on the effect of guided inquiry and lecture methods on students' academic achievement in biology: a case study of Yola north local government area of Adamawa State showed is a significant difference between the achievements of students taught with guided inquiry and those taught with lecture method in favour of guided inquiry. Guided inquiry proved more effective than lecture method in enhancing students' academic achievement in biology.

Furthermore, in a research carried out by Salihu (2015) on the effects of guided discovery approach on students' academic performance in ecology in senior secondary schools in Sokoto State, Nigeria, the results showed that students in experimental group (i.e. students

taught using guided discovery) performed better than those in control group (i.e. students taught using traditional method). This is an indication that students taught with guided discovery method performed significantly better than those taught with traditional method. It was also found that male students taught ecology with guided discovery performed better than their female counterparts. Students in private schools taught ecology with guided discovery also performed better than their counterparts in public schools. It was recommended that there is need for an in service training of biology teachers to be exposed to the use of guided discovery in teaching ecology and other biological concepts.

Mfon (2011) investigated the relative effectiveness of computer-based science simulations on students' achievement in chemistry at the secondary school level when compared with guided-discovery and the traditional expository teaching methods. The results showed that students taught by computer-based science simulations performed significantly better than those taught using the traditional expository method, (mean diff. = 4.34; sig. = .032), but had comparable performance with those taught with guided-discovery approach (mean diff. = .85; sig. =.869). That is, computer based simulation method is as effective as guided-discovery, but significantly better than the traditional expository method; and that gender is not a strong determinant of students' performance in chemistry. Based on the findings, it was recommended, among others, that chemistry teachers should adopt computer-based simulation technique in teaching chemistry concepts in view of its high facilitative effect on students' performance.

Akanmu (2013) investigated Guided-discovery Learning Strategy and Senior School Students Performance in Mathematics in Ejigbo, Nigeria alongside influence of gender and scoring levels ability of the students. The study revealed a significant difference in favour of those exposed to guided-discovery learning strategy compared to those not taught using guided-discover learning strategy. Though both male and female students performed equally well when taught using guided discovery strategy, the study showed that high scoring students benefited most while the performance of low scoring students was also enhanced. It was recommended among others that mathematics teachers should make the teaching-learning of mathematics an interactive and activity – based one for the students using strategy that all students could gain from irrespective of the ability levels of the students and, government both at Federal and State levels should periodically conduct regular workshops for teachers to develop a means of reviewing/assessing the impact of teaching strategies.

Review of some empirical studies on lecture teaching methods.

Roya, Mohammad and Faramarz (2014) in their study titled "comparison of the effect of lecture and blended teaching methods on students' learning and satisfaction", revealed that the blended method is effective in increasing the students' learning rate. E-learning can be used to teach some courses and might be considered as economic aspects. Since in universities of medical sciences in the country, the majority of students have access to the Internet and email address, using e-learning could be used as a supplement to traditional teaching methods or sometimes as educational alternative method because this method of teaching increases the students' knowledge, satisfaction and attention.

Furthermore, Ameh and Dantani (2012) carried out a study on effects of lecture and demonstration methods on the academic achievement of students in Chemistry in Nasarawa Local Government Area of Kano State. Results revealed that students perform better in Chemistry when taught using the demonstration method as compared to the lecture method. The boys and girls are better in academic achievement when taught using demonstration method than when lecture method was used. The demonstration method shows equality in the performance of boys and girls.

Abdu (2011) investigated the effectiveness of discussion method of teaching on students' achievement and retention in Social Studies. The result indicated that there was a significant difference between the pre-test and achievement mean scores of students in the experimental and control groups. There was a significant difference between the achievement mean scores of students in the experiment and control groups. There was a significant different between the retention mean scores of students in the experimental and control groups. There was a significant difference between the achievement mean scores and retention mean scores of students in the experimental and control groups. On the basis of the findings, it was concluded that discussion method was better than the conventional lecture method in improving students' achievement and retention in Social Studies. It was therefore recommended that the teachers of Social Studies should always use discussion method to impart knowledge to students to enable them participate actively in the lessons, interact with instructional materials and colleagues. The principals should create an enabling situation for the teaching of Social Studies in schools and the government should enforce through supervision the use of discussion method to teach Social Studies in schools. The government should also organize on-the-job trainings,

workshops, seminars, symposia and conferences at intervals for the teachers of Social Studies in secondary schools to update their knowledge on the application of the discussion method of teaching the subject.

Yusuf and Nuradeen (2012) carried out a study on the effects of integrating instructional models with lecture method on academic performance and retention of students of small class-size in some Biology concepts among Senior Secondary School Students in Zaria Education Zone. Results indicated that there is significant difference in the mean academic performance and retention of students taught Biology concepts using Integrating Instructional models with lecture method compared to those taught using lecture method of instruction in small class size. Based on the findings it was recommended that Integrating Instructional models with lecture method should be used by Biology teachers in Senior Secondary Schools. Biology teachers should be trained on effective use of instructional models in Senior Secondary Schools.

The concept of academic achievement in mathematics

Academic achievement is one of the psycho-social needs of an individual. Everyone wants to excel in one way or the other and this could be directed towards academic, occupation or social achievement. Okegbile (2007) indicated that academic achievement is a pedagogical terminology used while determining a learner's success in formal education and which is measured through reports, examinations, researches, ratings and test with numerous factors or variable exerting effects. Academic achievement refers to the index of general mental abilities, based on the individual's response to tests of different Kinds. Academic achievement is the ability to study and remember facts, study effectively and see how facts fit together to form large pattern of knowledge, to think of oneself in relation to facts and communicate knowledge verbally or down on paper.

In an academic-oriented culture like ours, one is judged by what one's achievements are, how they compare with those of others and the earlier in life the achievements are attained, the more prestigious the individual becomes. Everyone sets goals and objectives in life. If one's achievement meets with these goals, one is satisfied and happy and one's self esteem rises. If not, one feels one has failed and one's self-esteem reduces.

In educational achievement, academic success is judged by success in scholastic activities and one becomes demoralized when one is not performing well (Femi, 2009). People

have expressed opinions on the why and how of low academic achievements. They have linked this concept with various factors of which some are resident in the child, school, home, society and the government (Olushola, 2008).

Since achievement is the accomplishment of a task, child's personal achievement in different situation in the group, be it good or bad, could lead him to see himself/herself as a leader, loner, or maladjusted person. A child would develop compensatory defence mechanism such as physical ailment, rationalization, protection and so on, when faced with academic failure; and this would hinder him/her from making educational adjustment. Some others recognize academic achievement as a function of variables such as motivation, level of intelligence, teacher's professionalism, study habits, attitude to academic subjects (Dikko, 2008; Bakori, 2008).

In other words, the way a student views his schooling, the school environment and his attitude towards his/her teachers can affect his/her academic achievement positively or negatively.

The academic achievement of a student may be high, good, average, poor or low. Adeniyi (2007) outlined many factors that cause poor academic achievement. The factors include students' home background/environment, personality factors, use of library, and difficulty of the task, class size, teacher's factor and relevance of school subject to the student.

In assessing, the academic achievement of students a variety of grades could be used by different examination bodies. A teacher may record his/her test or examinations in two ways, numerical marks or scale and literal marks or scale could be put in numerical equivalent as:

70 - 100=	A	(Distinction)
60 - 69 =	B	(Credit)
50 - 59 =	C	(Credit)
40 - 49 =	D	(Pass)
30 - 39 =	F	(Failed)

The West African Examinations Council (WAEC) uses a nine point grading system in assessing the achievement of students. The grades range from A to F, with grades B and C further subdivided. The interpretation of the various grades is as follows:

A_1 - Excellent

B_2 - Very good

B_3 - Good

C_4 - Credit

C_5 - Credit

C_6 - Credit

D_7 - Pass

E_8 - Pass

F_9 - Fail

Source: (The West African Examinations Council Regulations and syllabuses for the West African Senior School Certificate Examination, 2014)

Any student that makes a C_6 and above is regarded as an achiever. Academic success could be defined in terms of the acquisition of different kinds of knowledge and cognitive skills. School examinations terminal and seasonal, often determine academic attainment.

Gender and academic achievement in mathematics

Human resources are of great importance to a nation because, not only do they constitute usable commodity but also determine how much can be achieved with the other resources. Thus where there is no manpower, developments in other areas are retarded (Nwankwor, 2004). According to Okeke (2004) the greatest asset of any country is its resources, and the rationality of the human resources determines the extent of political, economic and social development. He stated further that the level of education procurement determines the level of development in a country. The human resources a country has are the youths who are the future leaders of

the country. The youths who are the educated males or females determine the extent of development in the country.

In the 1840's when formal education was introduced in Nigeria, there were few females in school. At this time, women occupied lower positions than men in the social structure. Then, girls were considered suitable for marriage and child bearing. Another strong factor was that when girls marry, they leave their families of orientation for their families of procreation. This results in discrimination against the education of girls as money spent on their education was erroneously seen as beneficial only to the husband's family. In the evidence of sex difference, Amin (2000) investigated the gender differences in achievement in Cameroon advanced level mathematics examination and founds that males generally performed better than the females.

Oyewo, Ayeni and Adesina (2007) in a study of the gender imbalance in education as perceived by students in tertiary institutions of Oyo State recommended that government should carry out enlightenment programmes to sensitize parents and the society at large on the importance of educating the girl-child. The study investigated the perception of tertiary institutions students towards factors influencing gender imbalance in education. The result of the study revealed lack of self-esteem, poor self-image and non-assertive behaviour among the factors that make girls shy away or perform poorly in school and particularly in science, mathematics and technical subjects. This may not be unconnected with the fact as a female her social identity is permanently fixed and negatively evaluated.

In line with this, Bukoye (2007) conducted a study on factors militating against Girl-Child Education in Nigeria with implications for counseling. The study showed a lot of factors that militate against girl-child education in Nigeria. The factors range from family's low socio-economic status, the concept that male child is supreme compared to the female child to poor performance of female gender in schools. The study therefore affirms that with realistic and befitting counseling efforts, there is the possibility of total eradication of all forms of discrimination against girl child education.

School location and academic achievement in mathematics

Schools are generally located both in urban and rural areas. Many researchers have come out with the view that students in urban area achieve better than those in rural areas. The poor performance of students in mathematics could be attributed to lack of mathematics teachers as

majority of schools in urban areas are over staffed with professionally qualified teachers whereas this is not so with rural schools. On the issue of students' poor achievement in mathematics, Konyeme (2007) and Umar (2008) noted that inadequate supply of qualified science and mathematics teachers (in terms of quantity and quality) in our secondary schools especially in the rural areas, is responsible for students' low interest in science and mathematics.

Osokoya and Akuche (2012) investigated the effect of school location on students' learning outcomes in practical physics with 526 students from eight co-educational schools in Ibadan with four schools from Ibadan city and four schools from the rural areas of Ibadan. The results showed that school location has a significant effect on students' cognitive attainment. In line with this, Owoeye and Yara (2011) conducted a study on school location and academic achievement of secondary school students in Ekiti state. The study looked at the location of schools as it relates to academic achievement of students in the West African School Certificate Examinations (WASCE) results between 1990-1997 in 50 secondary schools in both rural and urban areas of the state. The results showed that there is a significant difference between students' academic achievement of rural and urban secondary schools in senior school certificate examination, with students in urban area having better academic achievement than their rural counterpart. They recommended that government should bridge the gap between the rural and urban locations by providing social amenities for teachers in the rural areas to put up their best in other to enhance better academic achievement of students in their final examinations like the SSCE.

Appraisal of the review

The literature that was reviewed examined the conceptual framework and empirical studies such as the concept of teaching and teaching methods, lecture teaching method, review of some empirical studies on guided discovery and lecture teaching methods, the concept of academic achievement in mathematics, effect of guided discovery teaching method on students' academic achievement in mathematics, effect of lecture teaching method on students' academic achievement in mathematics, gender and academic achievement in mathematics and School location and academic achievement in mathematics.

The conceptual framework of the study examined the effect of the independent variables on the dependent variable. As represented in the model of study, the independent variables were guided discovery and lecture teaching methods.

On the concept of teaching and teaching methods, it was observed that teaching constitutes the organization of activities that lead to the realization of the objectives of the curriculum. It was also observed that teaching method comprised principles and methods used in instruction. Furthermore, the review on guided discovery teaching method revealed that the instructor devises a series of statements or questions that guide the learners, step by step, making a series of discoveries that leads to a single predetermined goal.

In the same vain, literature reviewed on lecture teaching method revealed that the lecture is an oral method of getting across knowledge, concepts, skills, values, attitude, facts and information. It is presumed to be the oldest method of instruction and is synonymous with "chalk and talk". Whether the lecture method is an approved method of teaching science in our secondary schools is open to debate. The fact is that it is being used every day in the teaching of sciences in our secondary schools.

Many researches were carried out on either the effects of guided discovery or lecture teaching methods on students' academic achievement in most science subject areas but none known to the researcher was carried out on the effects of guided discovery and lecture teaching methods on students' academic achievement in mathematics in Delta North Senatorial District in Delta state. This is the gap that the study has filled.

CHAPTER THREE

RESEARCH METHOD AND PROCEDURE

The method and procedure were discussed under the following sub-headings:

Research design

Population of the study

Sample and sampling technique

Research instruments

Validity of instruments

Reliability of instruments

Treatment procedure

Method of data collection

Method of data analysis

Research design

The design of the study is quasi experimental design of the pre-test, post-test control group. It was a pretest posttest control group factorial design of 2x2x2 factorial. The design consisted of two instructional groups (guided discovery and lecture groups), gender at two levels (male and female) and school location (urban and rural). Two intact classes labelled A and B were used for the study in each of the schools selected. Intact class A served as the experimental group using the guided discovery teaching method while intact class B served as the control group using the lecture method. The variable matrix of the design is shown in table 1.

Table 1: Variable Matrix of the Design

Teaching Methods	Gender	School Location	Treatment (X)
Guided Discovery	Male and Female	Urban and Rural	O_1 X O_2

Lecture	Male and Female	Urban and Rural	O_3 O_4

O_1 O_3 = Pre-test

O_2 O_4 = Post-test

X = Treatment

Population of the study

The population of the study comprised of all senior public secondary school students in Senior Secondary 1 (SS1) in the nine local government areas of Delta North senatorial district in the 2015/2016 academic session. The population of the study was 6,453 (Table 2).

Table 2: Summary of Schools and Students by Local Government in Delta North Senatorial District.

Local Government Area	Number of Schools	Number of Students
Aniocha South	15	595
Aniocha North	17	570
Ika South	18	810
Ika North East	17	670
Oshimili South	11	915
Oshimili North	10	600
Ndokwa East	25	925
Ndokwa West	19	720
Ukwuani	12	648
Total	144	6,453

(Source: Planning, Research and Statistics Department of Delta State Ministry of Basic and Secondary Education, Asaba, February, 2014).

Sample and sampling techniques

The sample of the study consisted of 320 students drawn from four Secondary schools in Delta North Senatorial District. A purposive random sampling method was used in selecting the local government areas, schools and classes. The local government areas were: Aniocha North, Ika South, Ndokwa West and Oshimili South. A school each, with two intact classes from each school were selected from the local government areas selected on the bases of rural and urban areas. From Aniocha North local government area, Ezi Commercial Secondary School, Ezi (rural) was selected with sample size of 31 male and 24 female; from Ika south, Ogbemudein Secondary School, Agbor (urban) with sample size of 46 male and 50 female was selected; from Ndokwa West, Ndemili Grammar school, Ndemili (rural) with sample size of 39 male and 41 female was selected; while from Oshimili South, West-End mixed secondary school, Asaba (urban) with sample size of 47 male and 42 female was selected. Guided discovery method was used to teach the experimental group (intact class A) while lecture method was used to teach the control group (intact class B). The sample size has a total of 163 males and a total of 157 females. This gave rise to a total of 320 candidates that was sampled for the study (Table 3).

Table 3: The Analysis of School and Students Sampled in the Study.

Local govt. area	School	Location	Sex	Boys	Girls	Total
Aniocha North	Ezi Secondary School, Ezi	Rural	Mixed	31	24	55
Ika South	Ogbemudein Mixed Secondary School, Agbor	Urban	Mixed	46	50	96
Ndokwa West	Ndemili Grammar school, Ndemili	Rural	Mixed	39	41	80

Oshimili South	West-End Mixed Secondary School, Asaba	Urban	Mixed	47	42	89
		Total		**163**	**157**	**320**

Research instrument

Mathematics Achievement Test (MAT) shown in Appendix 2 was employed for data collection. It consisted of 30 multiple choice test items each with options labelled A to E developed by the researcher. The researcher preferred the multiple choice items due to its ease to measure simple and complex learning outcomes, as the method can be used to construct test items that requires the recall of fact, understanding, application, analysis, and evaluation, and for easy scoring of the responses from the respondents. The topic areas covered are Algebra, Probability and Statistics.

Validity of instrument

The Mathematics Achievement Test (MAT) was drawn from the Senior Secondary I (SSI) scheme of work. Thirty objective test items were drawn from the content areas and the instrument was given to three experienced mathematics teachers in secondary schools and test experts in the department of Guidance and Counselling, Delta State University, Abraka. The experts examined the instrument and ensured that the instrument covered the content area intended to be covered, and certified it for use for the study. In other to further enhance the validity of the instrument, a table of specification was used in drawing the test items. The table of specifications for the achievement test to determine its content validity was shown below:

Table 4: Table of Specifications for the Mathematics Achievement Test.

Content area	Knowledge (understanding) 40%	Comprehension (remembering) 30%	Application (thinking) 30%	Total

Algebra				
Expansion (10%)	1	-	1	2
Equations (10%)	2	1	1	4
Factorization (10%)	1	1	1	3
Probability				
Dependent events (15%)	2	1	1	4
Independent event (15%)	1	2	1	4
Statistics:				
Mean (10%)	2	2	2	6
Median (10%)	1	2	1	4
Mode (10%)	1	-	1	2
Ranges (10%)	1			
Total	12	9	9	30

The table of specifications is a two way grid showing the content area and number of questions taken from each of the cognitive levels. The table of specifications is used to ensure adequate coverage of all the content areas in line with the behavioural objectives. The table of specification also enhance the content validity of the instrument.

Reliability of the instrument

The Mathematics Achievement Test (MAT) was administered to 30 students of Ime-Obi secondary school, Agbor in Delta North outside the sampled schools. The scores were correlated using Kuder Richardson formula 20 and a reliability coefficient of 0.65 was obtained. Detailed computation is shown in Appendix 4.

Treatment procedure

i. Training of research assistants

Two Senior Mathematics Teachers (researcher assistants) from each of the selected schools were trained by the researcher for the study. The training lasted for two hours each day for four days with the teaching manual prepared by the researcher and provided in appendix five in respect of the two teaching methods (i.e. guided discovery and lecture methods). Ballot system was used to allocate teaching methods to the research assistants. Also, each research assistant was given copies of the teaching manual based on the teaching method allocated to the research assistant.

ii Treatment proper

After training the researcher assistants for the study, the Mathematics Achievement Test (MAT) was administered as a pretest to the students. Thereafter, treatment was given using intact class A as the experimental group with guided discovery teaching method. The teaching involved introduction of the topic, drawing students' attention to the instructional materials provided, using probing questions, encouraging student to draw conclusion, with the teacher directing students to discover the solutions to the problems. Each activity was followed by a little class discussion. The control group (intact class B) was taught the same content using the lecture method. Here, the students were taught factual knowledge of the content materials; the students listened, took down notes. Treatment lasted for a period of six weeks. Immediately after the treatment, the Mathematics Achievement Test (MAT) was re-administered to the students as a posttest and the scores were computed.

Method of data collection

Pretest was administered to the experimental and control groups using the Mathematics Achievement Test (MAT). The scores were obtained and recorded for each of the two groups. Posttest was administered to the two groups (after treatment was given to the experimental group using guided discovery teaching method which lasted for six weeks) with the same Mathematics Achievement Test (MAT). The scores were obtained and recorded. The coordination of data collection was done by the researcher and the research assistants trained for each of the sample schools selected.

Method of data analysis

The data collected with Mathematics Achievement Test (MAT) were organized and analyzed using mean and standard deviation for the research questions while the hypotheses were tested using t-test statistics at 0.05 level of significance.

CHAPTER FOUR

PRESENTATION OF RESULTS AND DISCUSSION

In this chapter, data collected were analysed. The results of the analysed data were presented. The research questions raised were answered using mean and standard deviation. The t-test statistics were used to test the hypotheses formulated for the study at 0.05 level of significance.

Table 5: Comparison of Pre-test Scores of Students taught with Guided Discovery and Lecture Methods.

Teaching Method	N	Score	SD	Std Error Mean
Guided Discovery	160	25.1	10.12	.69
Lecture	160	24.8	11.15	.63

Table 5 showed the mean and standard deviation of students under guided discovery and lecture methods. The guided discovery method has a mean of 25.1 and standard deviation of 10.12 while lecture method has a mean of 24.8 and standard deviation of 11.15. Both groups had low mean and high standard deviation. This implies that before the treatment, there was low achievement by the students. The standard deviations showed a heterogeneous achievement by the students.

Answering of research questions

Research question 1:

Is there any difference in students' achievement in mathematics between students taught using the guide discovery teaching method and those taught with the lecture teaching method?

Table 6: Comparison of Mean Achievement Scores of Students taught with Guide Discovery and those taught with Lecture Teaching Methods.

Teaching Method	N	Mean	Std. Deviation	Std. Error Mean
Guided Discovery	160	73.46	11.13	.88
Lecture	160	46.08	6.48	.51

Table 6 above showed that the mean and standard deviation of those taught with guided discovery method are 73.46 and 11.13 while those of taught with lecture teaching method are 46.08 and 6.48 respectively. Comparatively, a mean difference of 27.38 indicated that there is a difference in students' achievement in mathematics between students taught with guided discovery method and lecture teaching method.

Research question 2:

Is there any difference in students' achievement in mathematics between male and female students taught with the guided discovery teaching method?

Table 7: Comparison of Mean Achievement Scores of Male and Female Students taught with Guided Discovery Teaching Method.

Teaching Method	Groups	N	Mean	Std. Deviation	Std. Error Mean
Guided Discovery	Male	83	73.33	12.85	1.41
	Female	77	72.82	9.27	1.06

Table 7 above showed that the mean and standard deviation of male taught with guided discovery method are 73.33 and 12.85 while female taught with guided discovery method are 72.82 and 9.27 respectively. Comparatively, a mean difference of 0.51 indicated that there is no difference in students' achievement in mathematics between male and female students taught with the guided discovery teaching method.

Research Question 3:

Is there any difference between male and female students' achievement in mathematics taught with lecture teaching method?

Table 8: Comparison of Mean Achievement Scores of Male and Female Students taught with Lecture Teaching Method.

Teaching Method	Groups	N	Mean	Std. Deviation	Std. Error Mean
Lecture	Male	77	47.57	7.04	.80
	Female	83	44.69	5.60	.62

Table 8 above showed that the mean and standard deviation of male taught with lecture teaching method are 47.57 and 7.04 while female taught with lecture teaching method are 44.69 and 5.60 respectively. Comparatively, a mean difference of 2.88 indicated that there is no much difference in students' achievement in mathematics between male and female students taught with the lecture teaching method.

Research question 4:

Is there any difference in students' achievement in mathematics between students in rural schools and students in urban schools taught with guided discovery teaching method?

Table 9: Comparison of Mean Achievement Scores of Students in Rural and Urban Schools taught with Guided Discovery Teaching Method.

Teaching Method	Groups	N	Mean	Std. Deviation	Std. Error Mean
Guided Discovery	Urban	93	74.17	12.46	1.29
	Rural	67	53.34	12.99	1.59

Table 9 above showed that the mean and standard deviation of students in urban schools taught with guided discovery teaching method are 74.17 and 12.46 while students in rural schools taught with guided discovery teaching method are 53.34 and 12.99 respectively.

Comparatively, a mean difference of 20.83 indicated that there is a difference between students in rural schools and students in urban schools taught with guided discovery teaching method.

Research Question 5:

Is there any difference between urban and rural students' achievement in mathematics when taught with lecture method of teaching?

Table 10: Comparison of Mean Achievement Scores of Students in Urban and Rural Schools taught with Lecture Method of Teaching.

Teaching Method	Groups	N	Mean	Std. Deviation	Std. Error Mean
Lecture	Urban	93	68.65	15.74	1.63
	Rural	67	49.00	7.27	.89

Table 10 above showed that the mean and standard deviation of students in urban schools taught with lecture method of teaching are 68.65 and 15.75 while students in rural schools taught with lecture method of teaching are 49.00 and 7.27 respectively. Comparatively, a mean difference of 19.65 indicated that there is a difference between students in rural schools and students in urban schools, when taught with lecture method of teaching.

Table 11: t-test Comparison of Pre-test Scores of Students taught with Guided Discovery and Lecture Method.

Groups	N	Mean	SD	Df	t-cal.	t-crit.	Decision
Guided Discovery	160	25.1	10.12	318	0.25	1.96	Accepted
Lecture	160	24.8	11.15				

Table 11 should that t-calculated is less than t-critical. Hence, there is no significant difference in achievement of students under the guided discovery and lecture methods before the treatment.

Testing of research hypotheses

Hypothesis 1 (HO_1)

There is no significant difference in students' mean achievement test score in mathematics between students taught using the guided discovery teaching method and those taught using the lecture teaching method.

Table 12: t-test Comparison of Achievement Scores of Students taught with Guided Discovery and those taught with Lecture Teaching Methods.

Groups	N	Mean	SD	Df	t-cal.	t-crit.	Decision
Experimental Group (Guided Discovery Method)	160	73.46	11.13	318	26.90	1.96	HO_1 Rejected
Control Group (Lecture Teaching Method)	160	46.08	6.48				

Table 12 showed the t-test analysis of students' mean achievement test score in mathematics between students taught using the guided discovery teaching method and those taught using the lecture teaching method. Result showed that the t-calculated value of 26.90 was greater than the t-critical value of 1.96 at a degree of freedom of 318. Since the t-calculated value is greater than t-critical value at 0.05 level of significance, the null hypothesis therefore was rejected. Hence, there is a significant difference in students' mean achievement test score in mathematics between students taught using the guided discovery teaching method and those taught using the lecture teaching method.

Hypothesis 2 (HO_2)

There is no significant difference in students' mean achievement test score in mathematics between male and female students taught with the guided discovery teaching method.

Table 13: t-test Comparison of Achievement Scores of Male and Female Students taught with the Guided Discovery Teaching Method.

Guided Discovery Method (Gender)	N	Mean	SD	Df	t-cal.	t-crit.	Decision
Male	83	73.33	12.85	158	0.28	1.96	HO_2 Accepted
Female	77	72.82	9.27				

Table 13 showed the t-test analysis students' mean achievement test score in mathematics between male and female students taught with the guided discovery teaching method. Result showed that the t-calculated value of 0.28 was less than the t-critical value of 1.96 with a degree of freedom of 158. Since the t-calculated value is less than t-critical value at 0.05 level of significance, the null hypothesis therefore was accepted. Hence, there is no significant difference in students' mean achievement test score in mathematics between male and female students taught with the guided discovery teaching method.

Hypothesis 3 (HO_3)

There is no significant difference between male and female students' mean achievement test score in mathematics taught with lecture method of teaching.

Table 14: t-test Comparison of Achievement Scores of Male and Female Students taught with Lecture Teaching Method.

Lecture Teaching Method (Gender)	N	Mean	SD	Df	t-cal.	t-crit.	Decision

Male	77	47.57	7.04	158	2.87	1.96	HO_3 Accepted
Female	83	44.69	5.60				

Table 14 showed the t-test analysis male and female students' mean achievement test score in mathematics taught with lecture method of teaching. Result showed that the t-calculated value of 2.87 was less than the t-critical value of 1.96 with a degree of freedom of 158. Since the t-calculated value is less than t-critical value at 0.05 level of significance, the null hypothesis therefore was accepted. Hence, there is no significant difference between male and female students' mean achievement test score in mathematics taught with lecture method of teaching.

Hypothesis 4 (HO_4)

There is no significant difference in students' mean achievement test score in mathematics between students in rural schools and those in urban schools taught with guided discovery teaching method.

Table 15: t-test Comparison of Achievement Scores in Rural and Urban Schools taught with Guided Discovery Teaching Method.

Guided Discovery (School Location)	N	Mean	SD	Df	t-cal.	t-crit.	Decision
Urban	93	74.17	12.46	158	10.25	1.96	HO_4 Rejected
Rural	67	53.34	12.99				

Table 15 showed the t-test analysis students' mean achievement test score in mathematics between students in rural schools and those in urban schools taught with guided discovery teaching method. Result showed that the t-calculated value of 10.25 was greater than

the t-critical value of 1.96 with a degree of freedom of 158. Since the exact probability value is greater than the significant level of 0.05, the null hypothesis therefore was rejected. Hence, there is a significant difference in students' mean achievement test score in mathematics between students in rural schools and those in urban schools taught with guided discovery teaching method.

Hypothesis 5 (HO_5)

There is no significant difference between urban and rural students' mean achievement test score in mathematics taught with lecture method of teaching.

Table 16: t-test Comparison of Achievement Scores of Students in Urban and Rural Schools taught with Lecture Teaching Method.

Lecture Method (School Location)	N	Mean	SD	Df	t-cal.	t-crit.	Decision
Urban	93	68.65	15.74	158	9.51	1.96	HO_5 Rejected
Rural	67	49.00	7.27				

Table 16 showed the t-test analysis urban and rural students' mean achievement test score in mathematics taught with lecture method of teaching. Result showed that the t-calculated value of 9.51 was greater than the t-critical value of 1.96 with a degree of freedom of 158. Since the t-calculated value is greater than t-critical value at 0.05 level of significance, the null hypothesis therefore was rejected. Hence, there is a significant difference between urban and rural students' mean achievement test score in mathematics taught with lecture method of teaching.

Discussion of results

The results of the findings were discussed under the following headings.

1. The difference in students' achievement in mathematics between students taught using the guide discovery teaching method and those taught with the lecture teaching method.

2. The difference in students' achievement in mathematics between male and female students taught with the guided discovery teaching method.
3. The difference between male and female students' achievement in mathematics taught with lecture teaching method.
4. The difference in students' achievement in mathematics between students in rural schools and students in urban schools taught with guided discovery teaching method.
5. The difference between urban and rural students' achievement in mathematics taught with lecture method of teaching.

1. The difference in Students' Achievement in Mathematics between Students taught using the Guide Discovery Teaching Method and those taught with the Lecture Teaching Method.

The findings on the difference in students' achievement in mathematics between students taught using the guide discovery teaching method and those taught with the lecture teaching method, revealed that there is a difference in students' achievement in mathematics between students taught using the guide discovery teaching method and those taught with the lecture teaching method. Furthermore, hypothesis 1 tested also showed that there is a significant difference in students' mean achievement test score in mathematics between students taught using the guided discovery teaching method and those taught using the lecture teaching method. In other words, those taught with guided discovery teaching method performed better than those taught with lecture teaching method. This is in consonance with a research carried out by Salihu (2015) on the effects of guided discovery approach on students' academic performance in ecology in senior secondary schools in Sokoto State, Nigeria. The result of the study stated that students in experimental group (i.e. students taught using guided discovery) performed better than those in control group (i.e. students taught using traditional method). This is an indication that students taught with guided discovery method performed significantly better than those taught with traditional method. In the same vein, Ugwuadu (2010) in the study on the effect of guided inquiry and lecture methods on students' academic achievement in biology: a case study of Yola north local government area of Adamawa State, revealed that mean pretest scores of the experimental and control groups used for the study are insignificant. The mean posttest scores showed a wide difference. There is a significant difference between the achievements of students taught with guided inquiry and those taught with lecture method in favour of guided

inquiry. Guided inquiry proved more effective than lecture method in enhancing students' academic achievement in biology.

2. The Difference in Students' Achievement in mathematics between Male and Female Students taught with the Guided Discovery Teaching Method.

The findings on the difference in students' achievement in mathematics between male and female students taught with the guided discovery teaching method showed that there is no difference in students' achievement in mathematics between male and female students taught with the guided discovery teaching method. Hypothesis 2 also revealed that there is no significant difference in students' mean achievement test score in mathematics between male and female students taught with the guided discovery teaching method. This showed that male and female students taught with guided teaching method performed equally well. Ezenwani (2002) opined that the emphasis on instruction should be to enable student to participate in the process of knowledge not in its product. He asserted that knowledge is a process not a product, and that a student must make an active response for learning to occur. According to him, the student must be guided to develop interest in the learning process. What has to be taught, when and how to teach it are all curriculum questions that must be carefully answered for the purpose of guiding and stimulating the interest of the student. He recommends the guided discovery method for the teaching of the sciences at the senior secondary schools. Allen (2002) saw guided discovery as characterized by convergent thinking. The instructor devices a series of statement or questions that guide the learners, step by step, making a series of discoveries that leads to a single predetermined goal. In other words, the instructor initiates a stimulus and the learner reacts by engaging in active inquiry thereby discovering the appropriate responses.

3. The difference between Male and Female Students' Achievement in Mathematics taught with Lecture Teaching Method.

The findings on the difference between male and female students' achievement in mathematics taught with lecture teaching method showed that there is no difference between male and female students' achievement in mathematics taught with lecture teaching method. However, hypothesis 3 revealed that there is no significant difference between male and female students' mean achievement test score in mathematics taught with lecture method of teaching. This showed that male and female students' achievement in mathematics taught with lecture teaching method, has no significance difference. In line with this, Orlich et al (2010) said that

it is the taking of lecture notes which is the key factor in converting the potentially passive experience of listening to a lecture into the active experience of learning a lecture. According to them lectures retain a major educational role because they exploit evolved aspects of human nature to make learning easier and more effective. According to Hillier (2005) "lecture" as a teaching method makes it easier for information from spoken communication from reading, as it makes students focus attention and remember what is said than when students are required to work alone.

4. The difference in Students' Achievement in Mathematics between Students in Rural Schools and Students in Urban Schools taught with Guided discovery Teaching Method.

The findings on the difference in students' achievement in mathematics between students in rural schools and students in urban schools taught with guided discovery teaching method, showed that there is a difference in students' achievement in mathematics between students in rural schools and students in urban schools taught with guided discovery teaching method. Hypothesis 4 tested also revealed that there is a significant difference in students' mean achievement test score in mathematics between students in rural schools and those in urban schools taught with guided discovery teaching method. Students in urban areas performed better than those in the rural area taught with guided discovery teaching method. In relation to this, many researchers have come out with the view that students in urban area achieve better than those in rural areas. The poor performance of students in mathematics could be attributed to lack of mathematics teachers. Majority of schools in urban areas are over staffed with professionally qualified teachers whereas this is not so with rural schools. On the issue of students' poor achievement in mathematics, Konyeme (2007) and Umar (2008) note that inadequate supply of qualified science and mathematics teachers (in terms of quantity and quality) in our secondary schools especially in the rural areas, is responsible for students' low interest in science and mathematics, hence, poor achievement in the subject by students. Osokoya and Akuche (2012) investigated the effect of school location on students' learning outcomes in practical physics with 526 students from eight co-educational schools in Ibadan with four schools from Ibadan city and four schools from the rural areas of Ibadan. The results supports the hypothesis tested that school location has a significant effect on students' cognitive attainment.

5. The difference between Urban and Rural Students' Achievement in Mathematics when taught with Lecture Method of Teaching.

The findings on the difference between urban and rural students' achievement in mathematics taught with lecture method of teaching, showed that there is a difference between urban and rural students' achievement in mathematics taught with lecture method of teaching. More so, hypothesis 5 revealed that there is a significant difference between urban and rural students' mean achievement test score in mathematics taught with lecture method of teaching. A study conducted by Owoeye and Yara (2011) on school location and academic achievement of secondary school in Ekiti state. In the West African school certificate Examinations (WASCE) results between 1990-1997 in 50 secondary schools in both rural and urban areas of the state, showed that there is a significant difference between students' academic achievement of rural and urban secondary schools in senior school certificate examinations. Thus, this supports the result of the findings of this work.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

This chapter contained the summary of research, conclusion, contribution to knowledge, recommendations and suggestion for further research.

Summary of research

This study investigated the effect of guided discovery and lecture teaching methods on students' academic achievement in senior school mathematics in Delta North senatorial district.

To guide the study, five research questions and five hypotheses were formulated. The general purpose of this study was to examine the effect of guided discovery and lecture teaching methods on students' academic achievement in mathematics.

The design of the study was a quasi-experimental one. The population of the study comprised of all senior secondary public school students in Senior Secondary 1 (SS1) in the nine local government areas of Delta North senatorial district in the 2015/2016 academic session. The population of the study was 6,453. A purposive random sampling method was used in selecting the local government areas, schools and classes. The sample size was made up of 163 males and 157 females. Mathematics Achievement Test (MAT) was used for data collection which consisted of 30 multiple choice test items each with options lettered A to E that was developed by the researcher. The reliability of the instrument were estimated using Kuder Richardson formula 20 and a reliability coefficient of 0.65 was obtained as a measure of internal consistency. The research questions were analyzed using mean and standard deviation while the hypotheses were tested using t-test at .05 level of significance.

Major findings

Analysis of result revealed that guided discovery and lecture methods affect students' achievement in mathematics. It also revealed that there is a significant difference in students' achievement in mathematics between students taught using the guided discovery teaching method and those taught using the lecture teaching method. Those taught with guided discovery teaching method performed better than those taught with lecture teaching method.

The findings also showed that there is no difference in students' achievement in mathematics between male and female students taught with the guided discovery teaching

method. This implies that male and female students' achievement in mathematics is not different when taught with guided discovery teaching method. The findings also showed that there is no difference between male and female students' achievement in mathematics taught with lecture teaching method. Furthermore, the result revealed that there is a difference in students' achievement in mathematics between students in rural schools and those in urban schools taught with guided discovery teaching method. Students in urban areas performed better than those in the rural area taught with guided discovery teaching method. In the same vein, the findings showed that there is a difference between urban and rural students' achievement in mathematics taught with lecture method of teaching. Students in the urban areas performing better than those in rural areas.

Conclusion

The major conclusions reached from the findings of the results were that:

1. There is a significant difference in students' achievement in mathematics between students taught using the guided discovery teaching method and those taught using the lecture teaching method.
2. Those taught with guided discovery teaching method performed better than those taught with lecture teaching method.
3. There is no difference in students' achievement in mathematics between male and female students taught with the guided discovery teaching method.
4. There is a difference in students' achievement in mathematics between students in rural schools and students in urban schools taught with guided discovery teaching method.
5. Students in the urban areas performed better than students in rural areas in terms of students' achievement in Mathematics in lecture teaching method.

Recommendations

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

1. Guided discovery teaching method should be practised intensively by Mathematics teachers since the method has been proved effective in enhancing students' academic achievement.
2. Mathematics teachers should reduce the use of lecture method in teaching mathematics to enhance students' academic achievement.

3. Mathematics teachers should make the teaching-learning of mathematics an interactive and activity–based for the students using guided discovery method.
4. Government at all levels should periodically conduct regular workshops for teachers on the effective use of guided discovery teaching method.
5. Government should also encourage Mathematics teachers to use guided discovery method by providing the needed conducive environment for teaching and learning with adequate instructional materials.

Contribution to knowledge

This study has been able to contribute to knowledge in the following ways.

1. This study has helped to prove that guided discovery method enhances students' achievement in mathematics.
2. The study provided information that those taught with guided discovery teaching method performed better than those taught with lecture teaching method.
3. Students in urban areas performed better than those in the rural areas taught with guided discovery teaching method.
4. Male and female students achieve equally well as none achieved better than the other.

Suggestions for further research

As a result of the findings and limitation of the study, the researcher hereby suggest the following areas for further studies.

1. This study should be carried out in another senatorial district in Delta State and beyond.
2. The effects of other teaching methods such as demonstration, assignment, discussion methods that help in the teaching-learning of mathematics should be studied.
3. Studies should be carried out on the effects of study habits on students' academic achievement in Mathematics.

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APPENDIX 1

2004 – 2010 MATHEMATICS

WAEC RESULT

YEAR	TOTAL ENTRY	% TOTAL SAT	% CREDIT	% PASS	% FAIL	% ABS
2004	1,035,266	98.47	33.97	28.16	34.47	1.52
2005	1,080,133	97.65	38.20	25.36	34.41	2.34
2006	1,035,266	98.18	41.12	31.09	24.95	1.81
2007	1,170,523	98.34	46.76	26.73	24.24	1.66
2008	1,292,890	98.09	57.28	23.83	17.24	1.91
2009	1,292,009	98.22	47.04	25.56	23.41	1.78
2010	1,331,374	98.13	41.95	27.85	27.20	1.87

Source: (WAEC Research Division and Headquarter Office Lagos)

APPENDIX 2

DEPARTMENT OF CURRICULUM AND INTEGRATED SCIENCE, FACULTY OF EDUCATION DELTA STATE UNIVERSITY ABRAKA

MATHEMATICS ACHIEVEMENT TEST (MAT) FOR SS1 STUDENTS

Time: 1 hour

Instruction: you have one hour to answer the 30 questions

Write only the correct answer from letters A to E in the answer sheet provided. On no account must a student remove the question paper or answer sheet whether used or unused from the hall

1. What is the coefficient of Xy in the expansion of (3X – 2Y) (4x + 5y) (a) 10 (b) -7 (c) 7 (d) 12 (e) 23
2. What is the probability of throwing an odd number with a fair die? (a) 1/6 (b) ¼ (c) 1/3 (d) ½ (e) 2/5
3. Find X in x/2-x = 2/3 (a) 4 (b) 5/4 (c) 4/5 (d) ½ (e) 2
4. Find the sum of the root of the quadratic equation $X^2 + X – 9 =3$ (a) 12 (b) -7 (c) -1 (d) 1 (e) 12
5. Factorise am + an – bm – bn (a) $(m\mp n)(-a – b)$ (b) (m-n)(a+b) (c) (m+n)(a-b) (d) (m+n)(a+b) (e) m (m+n) (a+b)
6. The numbers 1,2,3,4, ….. 17 are placed in a container and one number is drawn at random. What is the probability that the number is odd? (a) 1/17 (b) 2/17 (c) 3/17 (d) 4/17 (e) 9/17
7. If 3 is a root of the quadratic equation $X^2 + bx – 15 = 0$, determine the value of b. (a) 1 (b) 3 (c) 4 (d) 2 (e) -2

8. There are 21 balls in a bag. Some red and some yellow. If a ball is chosen at random from the bag, the probability of choosing a red ball is 2/3. How many yellow balls are in the bag? (a) 7 (b) 14 (c) 21 (d) 28 (e) 35.
9. Below are the ages of 40 students in form vi

Age	12		13	14	15	16	17	18
No of students	5		12	10	3	3	5	2

What is the mean age of the students? (a) 12 yrs (b) 14 yrs (3) months (c) 14 yrs 6 months (d) 15 yrs (e) 16 yrs 3 months

10. Which of the following is/are not the measures of dispersion? (i) Range (ii) variance (iii) mode (a) (i) Only (b) (ii) Only (c) (iii) only (d) (i) and (ii) only (e) (i) and (iii) only
11. A box contains 2 red balls and 4 blue balls. A ball is drawn at random from the box and then replaced before a second ball is drawn. Find the probability of drawing 2 red balls. (a) 1/9 (b) ¼ (c) 1/3 (d) 4/9 (e) 2/3
12. If the mean of 3, 5, 8, K, 14 and 17 is 11, what is the value of K? (a) 58 (b) 38 (c) 19 (d) 11 (e) 9.67
13. A group of students measured a certain angle (to the nearest degree) and obtained the following results: 75^0, 76^0, 72^0, 73^0, 74^0, 79^0, 72^0
    72^0, 77^0, 72^0, 71^0, 70^0, 78^0, 73^0
    Find the mode
    (a) 79^0, (b), 78^0, (c) 74^0, (d) 73^0, (e) 72^0
14. The profit made by a hawker in 5 consecutive days of selling are: ₦8, ₦15, ₦ 20, ₦ 12, ₦ 15. what is the range of the profit? (a) ₦ 12 (b) ₦ 7 (c) ₦5 (d) ₦ 4 (e) ₦8
15. Expand (2x-5) (x-3) (a) $X^2 – 1 x – 15$ (b) $2 x^2 – 11x + 15$ (c) $2x^2 – 5 x – 8$ (d) $x^2 – 5x – 15$ (e) $2x^2 – 6x + 15$
16. A number is chosen at random from the set (1,2,3,…, 9,10) what is the probability that the number is greater than or equal to 7? 9a) 1/10 (b) 3/10 (c) 2/5 (d) 3/5 (e) 7/10
17. The mean of 20 observations in an experiment is 4. If the observed largest value is 23, find the mean of the remaining observations. (a) 4 (b) 3 (c) 2.85 (d) 2.60 (e) 2.56

18. Find the value of X, which satisfies the equation 5 (x -7) = 7 x -2x (a) 2 (b) 4 (c) 6 (d) 14 (e) 10
19. Factorise the expression $2x^2 + x – 15$ (a) (2x + 5) (x-3) (b) (2x – 5) (x+3) (c) (2x-5) (x-3) (d) (2x-3) (x+5) (e) (2x+5) (x+3).

The distribution of marks in a mathematics test is shown below:

Marks	0	1	2	3	4	5	6	7	8	9	10
Frequency	2	0	0	2	3	6	3	2	2	1	0

Use the table to answer questions 20 and 21

20. How many candidates took the test? (a) 20 (b) 21 (c) 22 (d) 23 (e) 24
21. What is the median score? (a) 3 (b) 4 (c)5 (d)6 (e) 7
22. A fair die is rolled once. What is the probability of obtaining 4 or 6? (a) 1/12 (b) 1/6 (c) 1/3 (d) ½ (e) 2/3
23. Find the median of the set of numbers 12, 15, 13, 14, 12,12. (a) 12 (b) 12. 5 (c) 13 (d) 13.5 (e) 14
24. The mean heights of the three groups of students consisting of 20, 16 and 14 students are 1.67m, 1.50m and 1.40m respectively. Find the mean height of all the students. (a) 1.52m (b) 1.53c (c) 1.54m (d) 1.55 (e) 1.52m
25. The marks obtained by a student in an examination are 27, 32, 33, 45, 59, 63, 75, and 90. Calculate the mean. (a) 53 (b) 35 (c) 55 (d) 40 (e) 45
26. What is the probability that an integer selected from the set of integers (20,21,….30) is a prime number? (a) 2/11 (b) 5/11 (c) 6/11 (d) 9/11 (e) 2/3
27. Find the roots of the equation $2X^2 – 3x – 2 = 0$ (a) x = - 2 or ½ (b) X = - 2 0r 1 (c) x = - ½ or 2 (d) x = - 1 or 2
28. What is the range of the following scores? 17.1, 50.3, 6.27, 33.2, 15.9, 66.05 and 24? (a) 59.78 (b) 44.03 (c) 29.89 (d) 24.0 (e) 15.75
29. From a box containing 2 red, 6 white and 5 black balls, a ball is randomly selected. What is the probability that the selected ball is black? (a) 2/13 (b) 5/13 (c) 5/11 (d) 5/6 (e) 11/13
30. Find the average of the first four prime number greater than 10, (a) 20 (b) 19 (c) 17 (d) 15 (e) B

Answer to the test items

1. C
2. D
3. C
4. C
5. C
6. E
7. D
8. A
9. E
10. C
11. A
12. C
13. E
14. A
15. B
16. C
17. B
18. C
19. B
20. B
21. C
22. C
23. B
24. C
25. A
26. A
27. C
28. A
29. B
30. D

APPENDIX 3

The analysis of school and students sampled in the study.

S/N	Local govt. area	School	Location	Sex	Boys	Girls	Total
1	Aniocha North	Ezi secondary school, Ezi	Rural	Mixed	31	24	55
2	Ika South	Ogbemudein mixed secondary school, Agbor	Urban	Mixed	46	50	96
3	Ndokwa West	Ndemili Grammar school, Ndemili	Rural	Mixed	39	41	80
4	Ohsimili South	West end mixed secondary school, Abasa	Urban	Mixed	47	42	89
			Total		**163**	**157**	**320**

Appendix 4

Detailed Computation of Kuder Richardson Formula 20

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Total
1	1	1	0	0	0	1	1	0	1	1	1	0	1	0	1	1	1	0	1	1	1	0	1	0	1	0	1	1	1	0	19
2	0	0	1	0	1	0	1	0	1	0	1	1	0	1	0	0	1	0	1	0	0	0	1	1	0	1	0	0	1	0	13
3	1	0	0	1	0	0	1	0	0	1	0	0	1	0	1	0	0	0	1	0	1	0	0	0	0	0	0	1	0	1	10
4	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	1	0	1	0	0	0	7
5	1	0	1	0	1	1	1	0	1	0	1	1	0	1	0	1	1	1	0	1	1	0	1	1	0	1	1	0	1	1	20
6	0	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	0	0	0	0	0	1	0	0	1	0	0	1	0	0	8
7	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	1	0	1	0	1	0	0	1	0	0	1	0	1	0	9
8	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0	1	0	1	0	0	6
9	1	1	1	0	1	1	0	1	1	0	0	1	0	1	0	1	0	1	0	1	0	1	1	0	1	0	1	0	0	1	17
10	1	1	0	1	0	0	1	0	0	1	0	0	1	0	1	0	1	0	1	0	1	0	0	1	0	1	0	1	0	0	13
11	0	0	1	0	0	1	0	0	1	0	0	1	0	0	0	1	0	0	0	1	0	1	0	0	1	0	1	0	1	0	10
12	1	1	0	1	0	0	1	1	0	0	1	0	0	1	1	0	1	0	1	0	1	0	1	1	0	1	0	1	0	0	15
13	0	0	1	0	0	1	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	7
14	0	1	0	1	1	0	1	1	0	0	0	1	1	0	1	1	0	0	0	1	1	0	0	0	1	0	0	0	1	0	13
15	1	0	1	0	1	1	0	1	1	1	1	0	0	1	0	0	1	1	1	1	0	1	1	1	0	1	0	1	1	1	20

16	**0**	**1**	**0**	**1**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**1**	**1**	**0**	**1**	**1**	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**1**	**1**	**0**	**1**	**0**	**1**	**1**	**15**
17	**1**	**0**	**1**	**0**	**1**	**1**	**0**	**1**	**0**	**1**	**1**	**0**	**0**	**1**	**0**	**0**	**1**	**0**	**1**	**1**	**0**	**1**	**1**	**0**	**1**	**1**	**1**	**0**	**1**	**1**	**18**
18	**0**	**1**	**0**	**1**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**9**
19	**1**	**0**	**1**	**0**	**1**	**1**	**0**	**1**	**0**	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**1**	**0**	**1**	**1**	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**1**	**0**	**16**
20	**0**	**1**	**0**	**1**	**0**	**1**	**1**	**0**	**1**	**1**	**0**	**1**	**1**	**0**	**1**	**1**	**0**	**1**	**0**	**0**	**1**	**0**	**1**	**1**	**0**	**1**	**1**	**1**	**0**	**1**	**18**
21	**0**	**1**	**1**	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**1**	**0**	**1**	**1**	**0**	**1**	**0**	**0**	**1**	**0**	**1**	**1**	**0**	**0**	**13**
22	**1**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**1**	**0**	**9**
23	**0**	**1**	**1**	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**	**11**
24	**1**	**1**	**0**	**1**	**1**	**1**	**1**	**0**	**1**	**1**	**0**	**1**	**1**	**1**	**1**	**0**	**1**	**1**	**0**	**1**	**0**	**1**	**1**	**0**	**1**	**1**	**1**	**1**	**1**	**1**	**23**
25	**1**	**0**	**1**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**1**	**1**	**0**	**1**	**1**	**0**	**1**	**1**	**0**	**1**	**1**	**1**	**0**	**1**	**0**	**1**	**16**
26	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**7**
27	**1**	**0**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**1**	**1**	**1**	**0**	**0**	**1**	**1**	**0**	**0**	**1**	**1**	**0**	**16**
28	**0**	**1**	**0**	**1**	**0**	**1**	**1**	**1**	**1**	**0**	**0**	**1**	**1**	**1**	**0**	**0**	**0**	**1**	**0**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**15**
29	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**1**	**0**	**9**
30	**1**	**1**	**0**	**0**	**1**	**1**	**1**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**12**
P	**.5**	**.5**	**.4**	**.3**	**.4**	**.5**	**.5**	**.4**	**.4**	**.4**	**.5**	**.4**	**.4**	**.4**	**.4**	**.5**	**.3**	**.3**	**.4**	**.4**	**.5**	**.4**	**.4**	**.4**	**.4**	**.4**	**.5**	**.5**	**.5**	**.4**	**394**
Q	**.5**	**.5**	**.6**	**.7**	**.6**	**.5**	**.5**	**.6**	**.6**	**.6**	**.5**	**.6**	**.6**	**.6**	**.6**	**.6**	**.5**	**.7**	**.7**	**.6**	**.6**	**.5**	**.6**	**.6**	**.6**	**.6**	**.5**	**.5**	**.5**	**.6**	**13.13**
Pq	**.25**	**.25**	**.24**	**.21**	**.24**	**.25**	**.25**	**.24**	**.24**	**.24**	**.75**	**.24**	**.24**	**.25**	**.21**	**.21**	**.21**	**.24**	**.24**	**.25**	**.24**	**.24**	**.24**	**.24**	**.24**	**.24**	**.25**	**.25**	**.25**	**.24**	**8.19**

$\overline{X}$ = 13.13

$\sum pq = 8.19$

$\sum (X - \overline{X})^2 = 657.04$

Variance = 21.90

$$K - R\ 20 = \frac{n}{n-1}\left(1-\frac{\sum pq}{S^2}\right)$$

$$= \frac{30}{30-1}\left(\frac{1-8.19}{21.90}\right)$$

$$= \frac{30}{29}\left(\frac{1 - 0.373972602}{}\right)$$

= 1.034482759 (0.626027398)

=0.65

APPENDIX 5
Guided Discovery Method: Lesson Format
Lesson I

Subject:	Mathematics
Class:	SSI
Age:	13+
Lesson duration:	40 mins per period of 2
Topic:	Expansion of Algebric expression and factorization of quadratic equation/expression.

Lesson Objectives

At the end of the lesson, students should be able to

i. Expand algebraic expressions by removing brackets
ii. Multiply binomial
iii. Factorize quadratic expressions/equations.

Instructional Materials

New concept mathematics for senior secondary schools I, a rectangular chalk box, cardboard paper, chalkboard.

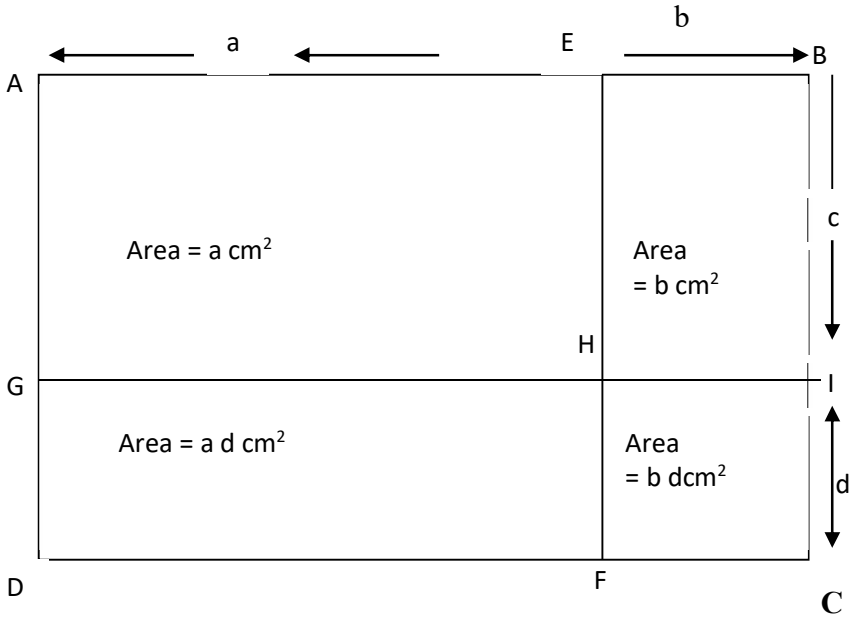
Lesson procedure:

Period1:

Expansion of algebraic expressions

Activity:

To find the area of a rectangular chalk box ABCD, (a+b) cm long and (c+d) cm wide. The students are allowed to handle an empty rectangular chalk box and to observe the dimension of the length and width and note the difference in lengths, and then draw the rectangle. The area of the rectangle ABCD is equal to (a+b) cm x (c+d) cm



Area of rectangle AEHG = a x c = ac cm^2

Area f rectangle GHFD = a x d = ad cm^2

Area of rectangle EBIH = b xc = bc cm^2

Area of rectangle HICF = b x d = bd cm^2

Adding up the areas of the four rectangles we have

(ac + ad + bc + bd) cm^2

This is equal to the area of the rectangle ABCD. The students should be guided to understand that the product (a+b) (c+d) of the binomials (a+b) and (c+d) can be expanded in two ways as shown below.

(a+ b) (c+d) = (a+b) C + (a+ b) d

= ac+bc + ad+bd

Or

(a+ b) (c+d) = a (c+d) + b (c=d)

= ac + ad + bc + bd

Note that the result is same in both cases.

Example

1. Find the product of the binomial expression (2a+3) (2a-6)

Solution

The teacher guides the students to take the first factor in the first bracket and multiply it with the factors of the second bracket i.e.

2a (2a-6)

Again, the teacher guides the students to take the second factor in the first bracket and multiply it with the factors in the second bracket i.e.

+ 3 (2a-6)

= 2a (2a-6) + 3 (2a-6)

= 2a x 2a + 2a x (-6) + 3 x 2a + 3 x (-6)

= $4a^2 – 12a + 6a - 18$

= $4a^2 – 6a – 18$

2. Expand and simplify as far as possible (x – 2) (x – 11)

Solution

(x – 2) (x – 11)

= x (x – 11) – 2 (x – 11)

= $x^2 – 11x – 2x + 22$

= $x^2 – 13 x + 22$

Period 2

Factorization of quadratic expression/equations:

The teacher writes some expressions on the chalk board.

Examples:

$X^2 + 5x$

$X^2 – 6 x + 10$

$8 x^2 – 21 x – 9$

$r^2 – 36$ etc

The teacher instructs the students to observe the expressions, and say what they observed.

Observations:

1. the first three expressions have x variables
2. the first and last expressions have only two terms
3. the second and third expressions have only 3 terms

4. the first three expressions have two as the highest power of the variable x

What is a quadratic expression?

From the last answer given, the teacher guide the students to understand that any expression which has two as the highest power of the unknown is called a quadratic expression, which is of the form $ax^2 + bx + c$ (where a, b and c are constant and $a \neq 0$). When an equality sign is introduced after the quadratic expression and we write zero, what will the expression become?

ie $ax^2 + bx + c$

$=> ax^2 + bx + c = 0$

Answer: an equation

A quadratic expression that equates to zero is called a quadratic equation.

Examples

1. factorize the quadratic expression:

   $2x^2 + 11x + 5$

   Solution

The teacher ask the students to identify the terms in the expression:

First term = $2x^2$

Middle term = $11x$

Last term (constant term) = 5. The teacher ask them to find the product of the first and last terms

i.e. $2x^2 \times 5 = 10x^2$

The teacher ask the students to find two factors such that the product of those two factors will give the same thing as the product of the first and last term i.e. $10x^2$ and the sum of the two factors will give the same thing as the middle term in the expression.

i.e.

Two factors, when multiplied together gives the same thing as the product of the first and last term are:

X and 10x sum of x and 10x = 11x.

The teacher instructs students to replace the middle term in the equation with these two factors, we have:

$2x^2 + 11x + 5 => 2x^2 + x + 10x + 5$.

The teacher asks the students to group the expression ie $(2x^2 + x) + (10x + 5)$. Ask them of the common factors in each bracket, then, bring out the common factors

i.e. $x(2x+1) + 5(2x+1)$

= (x + 5) (2 x + 1).

Class work (Evaluation)

Factorize the quadratic equation:

=>b^2+ 6b – 16 = 0

Correction

1st term = b^2

Last term = - 16

Product of 1st and last term

= b^2 x (-16)

= - 16b^2

Two factors that can give same result as – 16b^2 are – 2b and 8b

ie - 2b x 8b = - 16b^2

- 2b + 8b = 6b

Then, replace the middle term in the equation b^2 + 65 – 16 = 0 with these two factors ie (- 2b and 8b)

= b^2 + 6b – 16 = 0

ie b^2 – 2b + 8b – 16 = 0

grouping, we have:

(b^2 – 2b) + (8b-16) = 0

Factorizing, we have

b(b-2) + 8 (b-2) = 0

(b+8) (b-2) = 0

Lesson 2

Probability

Lesson objectives

At the end of the lesson, students should be able to:

i. define probability
ii. find the probability of an event taking place

Instructional Materials

Different colours of small balls, empty carton, chalkboard.

Activity:

The teacher brings an empty carton. Ask the students to put 3 different colours of 2 red balls, 5 blue balls and 6 white balls into the carton. Ask them to close their eyes and take a ball (at random), say a red ball out of the balls in the carton. Ask the students to explain what they have just done. Some many say: game of chance. Others may say: trial and error. Guide the students to understand that in everyday life, expectations may either come as expected event or unexpected event. When for instance, somebody does business, the person either succeeds or fails on the business. Whatever happens, everything a person attempts to do is a trial, while the result of such "attempts" is the outcome. Similarly, if in a carton containing 2 red balls, 5 blue balls and 6 white balls, we want to close our eyes and take a ball (at random), the chances of taking a red ball will definitely be the "Red balls" out of the total number of "out come"

ie $\frac{\text{Red balls}}{\text{Total number of balls}}$

All the happenings and their respective results
described above are expectations which may likely occur or not. This is the basis of probability.
The teacher then, ask the students to define probability.

Definition:

Probability is the measure of the result or outcome of expectations (events) in numerical form. Mathematically,

Probability = $\frac{\text{Number of required outcome}}{\text{Number of possible outcome}}$

Examples

1. A bag contains 2 black balls, 3 red balls and 6 white balls. A ball is picked from the bag at random. What is the probability that it is.
   a. Black
   b. Red
   c. Not red?

Solution

Ask the students to determine the total number of balls.

Answer: 11

The teacher asks them how they got 11 balls. This is done by counting the black, red balls and white balls together.

The teacher guide the students to recall that;

Since Probability = $\frac{\text{No. of required outcome}}{\text{No. of possible outcome,}}$

Then

a. Probability of a black ball = $\frac{\text{No. of black balls}}{\text{Total no of balls}}$

$= 2/11$

b. Probability of not a red ball

$= \frac{\text{No. that is not red}}{\text{Total no. of balls}}$

$= \frac{\text{white balls + black ball}}{\text{Total no. of balls}}$

$= \frac{6 + 2}{11}$

$= 8/11$

Evaluation: the teacher gives the students homework

A bag contains 3 black, 4 yellow and 7 red balls. A ball is picked from the bag at random, what is the probability that it is:

a. Yellow
b. White
c. Not black?

Period 2

Independent events (multiplication of probability).

Instructional material: 2 coins, dice.

Activity

The teacher tell the students to clap their hands and sing at the same time. Again, make them to clap and jump up at the same time. Ask them if any of those actions affect the other. The answer is No. Ask the students to throw the dice supposing one die shows a 3 and the other die a 5. It is also possible that both dice show a 5. Guide the students to understand that in each of the events above, it is discovered that the occurrence of one event has no effect on the other. Such events are said to

be independent. Therefore if two events can occur without affecting each other, then the two events are independent events. The probability of two or more events are found by multiplying the probability of the various events that are involved. Words such as “and”, “both”, “all” are usually used.

Examples

A basket contains 3 red balls, 5 blue balls and 7 green balls. Two balls are picked one after the other without replacement. Find the probability that:

a. both are red
b. One is blue, the other is green
c. first is blue, the other is green
d. both are of different colours

Solution

The teacher guides the students by asking:

a. What is the total number of balls? 3 red + 5 blue + 7 green = 15 balls. Since we are picking two balls one after the other without replacement, the process goes thus:

   1st draw of red ball =?

   = 3/15

Since 1 red ball was taken without replacement, how many red balls are left?

Answer = 2

What is the total ball left?

Answer = 14

In the process f drawing a second red ball, 2nd red ball drawn = 2

∴ Probability of both red = $\frac{3}{15} \times \frac{2}{14}$

$= \frac{1}{} \times \frac{1}{}$

$$= \frac{5}{15} \times \frac{7}{14}$$

$$= \frac{1}{35}$$

b. Since the question did not specify whether the 1st or the 2nd is the blue, probability of one blue, one green.

i.e. Prob.(1st blue, 2nd green) or Prob.(1st green, 2nd blue)

$= (^5/_{15} \times ^7/_{14}) + (^7/_{14} \times ^5/_{15})$

$= (^1/_3 \times ½) + (^1/_2 \times ^1/_3)$

$= ^1/_6 + ^1/_6$

$= ^{1+1}/_6$

$= ^2/_6$

$= ^1/_3$

C. Prob.(1st blue, 2nd green)

$= ^5/_{15} \times ^7/_{14}$

$= ^1/_3 \times ½$

$= ^1/_6$

D. Prob. of different colours

= P(RB or RG or BG) or P(BR or GR or GB)

$= [(^3/_{15} \times ^5/_{14}) + (^3/_{15} \times ^7/_{14}) + (^5/_{15} \times ^3/_{14})] + [(^5/_{15} \times ^3/_{14}) + (^5/_{15} \times ^3/_{14}) + (^7/_{15} \times ^3/_{14}) + (^7/_{15} \times ^5/_{14})]$

$= (^{15}/_{210} + ^{21}/_{210} + ^{35}/_{210}) + (^{15}/_{210} + ^{21}/_{210} + ^{35}/_{210})$

$= ^{71}/_{210} + ^{710}/_{210}$

$= ^{142}/_{210}$

$= ^{71}/_{105}$

Evaluation: the teacher gives the students home work:

A bag contains 3 black balls and 5 yellow balls. Two balls are taken at random one after the other without replacement. Find the probability that:

i. they are both black
ii. they are both yellow
iii. The first is yellow, the second is black
iv. one is yellow the other is black
v. They are of the same colour

Lesson 3

Statistics (range, mean, median, mode).

Lesson Objectives

At the end of the lesson, students should be able to determine

i. range
ii. mean
iii. median
iv. mode of any set of number.

Instructional Materials:

Stones, cards, small sticks

Activity

The teacher puts the students into 3 groups and give them some objects to hold. Ask the 1st group of students to count the number of stones given to them. Second group of students, the cards and to the third group, the small sticks.

First group: No of stones = 20

Second group: No of card = 10

Third group: No of sticks = 6

The teacher asks the students:

(i) What is the highest score?

i.e. 20

(ii) What is the lowest score?

i.e. 6

(iii) What is the difference between the highest score and the lowest score?

Difference 20-6 = 14

The result which is 14 is called the range.

Range = highest score – lowest score.

Again, the teacher ask the students to count the total number of stones, cards and sticks together.

Answer 20 + 10 + 6

= 36

The teacher guides the students by asking: how many types of items do we have in the above case? Three (i.e. stones, cards, sticks). Supposing these three items represents individuals, and given 36 items to share, how many will each individual received?

Answer: 12. How?

Divide the number of items by the number of individuals represented. i.e 36/3 = 12

$\therefore$ Mean $(\overline{X})$ = $\frac{\text{sum of observation}}{\text{Total no of observation}}$

Examples

Find the range and mean of the set of scores: 25, 20, 29, 27, 30, 35, 25, 28.

Solution

Highest score = 35

Lowest score = 20

Range = highest score – lowest score

= 35-20

= 15

Mean ($\overline{X}$) = $\frac{\text{Sum of observation}}{\text{Total no of observation}}$

$\overline{X} = \frac{25 + 20 + 29 + 27 + 30 + 35 + 25 + 28}{8}$

$\overline{X} = \frac{219}{8}$

$\overline{X} = 27.4$

Activity:

The teacher guides the students to do the following:

Consider the set of scores: 3,9,5,8,6. The teacher instructs the students to arrange the scores in ascending order (i.e. from lowest score to highest score) i.e. 3,5,6,8,9. The teacher again, asks the students to count the scores either from the left or right hand side. The teacher asks the students to say their observations.

Observation: When the numbers were arranged in ascending order, the number 6 occurred as the middle number, counting either from the left or right. The teacher disclose to the students that: the middle number is called the median, and ask them to say the median of the set of scores above. Answer: 6. Again, the teacher ask: in a situation where the number occurs twice as the middle number, what will be the median? Answer: sum of the two middle number divide by 2.

The teacher again, gives another set of scores e.g. 2,6,6,6,6,9,10,10. In the set of scores above, how many times did the number 6 occur? Answer: 4 times. The teacher guides the students to understand that 6 occurred most (i.e. the number that has the highest frequency). This is called the mode.

Examples

1. Find the median of: 53,50,47,48,51, 52,58,90, 54,50

Solution

The teacher guiding the students, instructs them thus:

(i) Arranging the numbers in ascending order, we have

47,48, 50, 50, 51,52, 53, 54, 58,90

(ii) Counting from the left or right hand side, determine the median by adding the two middle numbers. i.e.

Median = $\frac{51 + 52}{2}$

$= \frac{103}{2} = 51.5$

2. What is the mode of the following set of score: 2,2,2,5,7,8,9?

Solution: The teacher guides the students to observe the set of scores and say the number that occurred most.

Answer: The number, 2, occurred most.

:. Mode = 2

Exercise

Find the mean, median and mode of the following set of scores:

320, 350, 400, 500, 450, 500, 455,375.

Appendix 6

Lecture method: lesson format

Lesson I

Subject:	Mathematics
Class:	SS I
Age:	13+
Sex:	Mixed
Lesson duration:	40 Mins per period of 2.
Topic:	Expansion of Algebraic expressions and factorization of quadratic expression/equation.

Lesson Objectives

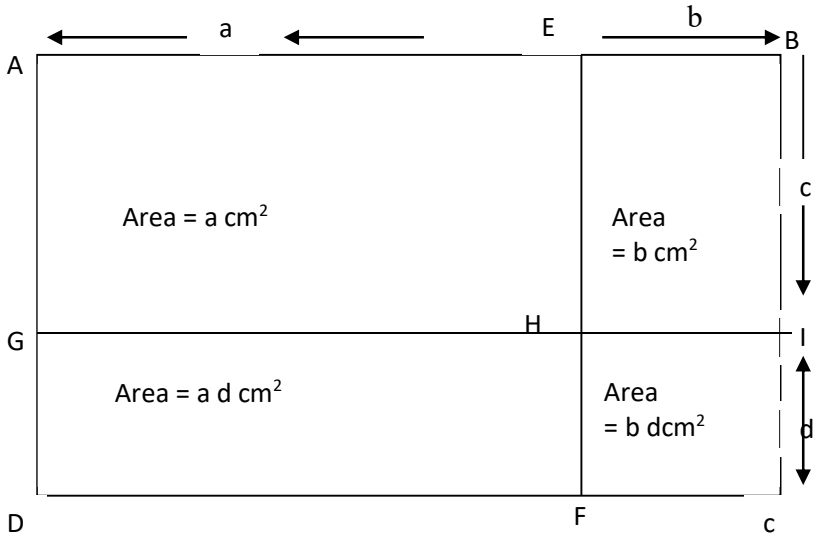
At the end of the lesson, students should be able to:

i. expand algebraic expressions by removing bracket
ii. multiply binomial expressions
iii. factories quadratic expressions

Period I

Expansion of algebraic expressions

The teacher draws the diagram of a rectangle on the board with the dimensions given.



The teacher derives the area of the rectangle thus:

Area of rectangle AEHG = ac Cm^2

Area of rectangle GHFD = ad Cm^2

Area of rectangle EBIH = bc Cm^2

Area of rectangle HICF = bd Cm^2

∴Area of rectangle ABCD = (ac + ad + bc + bd) Cm^2

Examples

1. Find the product of the binomial expression (2a+3) (2a-6)

   Solution: The teacher expands the expression by multiplying what is in the second bracket by the factors in the first bracket thus:

   (2a+3) (2a – 6)

   = 2a (2a -6) + 3 (2a – 6)

   = $4a^2$ – 12a+ 6a-18

   = $4a^2$ – 6a – 18

2 Expand and simplify as far as possible (x – 2) (x – 11)

Solution: The teacher expands the expression by multiplying what is in the second bracket by the factors in the first bracket thus:

$(x - 2)(x - 11)$

$= x(x - 11) - 2(x - 11)$

$= x^2 - 11x - 2x + 22$

$= x^2 - 13x + 22$

Period 2

Factorization of quadratic expression/equations.

The teacher defines a quadratic equation thus:

Definition

A quadratic express is an expression that has 2 as the highest power of its variable.

It is of the form $ax^2 + bx + c$.

The teacher tells the students the difference between a quadratic expression and a quadratic equation.

A quadratic expression becomes a quadratic equation when the expression is equated to zero ie $ax^2 + bx + c = 0$ (where a, b and c are constant).

Examples

1. Factorize the quadratic expression $2x^2 + 11x + 5$

Solution

$2x^2 + 11 \times 5$

The teacher finds two factors i.e. x and 10x and replaces the middle terms in the original expression with the two factors found. i.e.

$= 2x^2 + x + 10x + 5$

The teacher groups the expression thus

$= (2x^2 + x) + (10x + 5)$

The teacher factorizes by bringing out the common factors in each bracket i.e.

$= x\ (2x+1) + 5\ (2\ x + 1)$

The teacher takes the factors outside bracket and take one of the common factors inside the bracket and group them. i.e.

$= (x+5)\ (2x+1)$

Class work

Factorize the quadratic equation

$b^2 + 6b – 16 = 0$

Correction

$b^2 + 6b – 16 = 0$

The teacher finds two factors and use these factors to replace the middle term in the original equation. i.e.

$b^2 - 2b + 8b – 16 = 0$

The teacher groups the equation thus:

$(b^2 – 2b) + (8b-16) = 0$

The teacher factorizes:

$b(b-2) + 8\ (b-2) = 0$

The teacher write down the solution.

$(b+ 8)\ (b-2) = 0$

Lesson 2

Probability

Lesson objectives

At the end of the lesson, students should be able to:

i. Define probability
ii. Find the probability of an event taking place.

The teacher defines probability:

Definition

Probability is the measure of the result or outcome of expectations (events) in numerical form.

Mathematically,

$$\text{Probability} = \frac{\text{No. of required outcome}}{\text{No. of possible outcome}}$$

Examples

1. A bag contains 2 black balls, 3 red balls and 6 white balls. A ball is picked from the bag at random. What is the probability that it is:

a. black

b. Red

c. Not red?

Solution

a. Probability of black ball

$$= \frac{\text{No. of black ball}}{\text{Total no. of balls}}$$

$$= \frac{\text{White balls + black balls}}{\text{Total no. of balls}}$$

$$= \frac{6+2}{11}$$

= 8/11

Evaluation: the teacher gives the students home work.

A bag contains 3 black, 4 yellow and 7 red balls. A ball is picked from the bag at random, what is the probability that it is

a. Yellow.
b. White
c. Not black?

Period 2

Independent events (Multiplication of Probability)

Example

A basket contains 3 red balls, 5 blue balls and 7 green balls. Two balls are picked one after the other without replacement. Find the probability that:

a. Both are red
b. One is blue, the other is green
c. First is blue, the other is green
d. Both are of different colours.

Solution

The teacher finds the probability by multiplying p(1^{st} red) x p(2^{nd} red) i.e.

a. Probability of both red = 3/15 x 2/14

= 1/5 x 1/7

= 1/35

b. The teacher finds:

Prob. (1^{st} blue, 2^{nd} green) or prob. (1^{st} green, 2^{nd} blue)

= (5/15 x 7/14) + (7/14 x 5/15)

= (1/3 x ½) + (½ x 1/3)

= 1/6 + 1/6

2/6

= 1/3

C. The teacher finds:

Prob. (1st blue, 2nd green)

= 5/15 x 7/14

= 1/3 x ½

= 1/6

The teacher finds the probability of different colours thus:

D. probability of different colours =

P (RB or RG or BG) OR P (BR or GR or GB)

[(3/15 x 5/14) + (3/15 x 7/14) + (5/15 x 7/14)] + [7/15 x 3/14) + (7/15 + 3/14) + (7/15 x 5/14)]

= (15/210 + 21/210 + 35/210) + (15/210 + 21/210 + 35/210

= 71/210 + 71/210

= 142/210

= 71/105

Evaluation: The teacher gives the students home work

A bag contains 3 black balls and 5 yellow balls. Two balls are taken at random one after the other without replacement.

Find the probability that:

i. they are both black

ii. they are both yellow
iii. the first is yellow, the second is black
iv. one is yellow the other is black
v. they are of the same colour.

Lesson 3

Statistics (range, mean, median, made).

Lesson Objectives

At the end of the lesson, students should be able to determine

i. range
ii. mean
iii. median
iv. mode of any set of number.

Definitions

The teacher defines:

(i) Range is the difference between the highest score and the lowest score in a given set of scores.

ie Range = highest score – lowest score

(ii) Mean is the sum of observation divide by the total number of observation

i.e. Mean $(\overline{X})$ = Sum of observation

Total no. of observation

Examples

Find the range and mean of the set of scores: 25, 20, 27, 30, 35, 25, 28.

Solution

Range = highest score – lowest score

= 35 – 20

= 15

Mean $(\overline{X})$ = Sum of Observation

Total no. of observation

$(\overline{X}) = \frac{25 + 20 + 29 + 27 + 30 + 35 + 25 + 28}{8}$

$(\overline{X}) = \frac{219}{8}$

$(\overline{X}) = 27.4$

Period 2

Median

The teacher explains to the students what median is:

Median is the middle number in a given set of numbers when arranged in order of magnitude when two numbers occur as the middle number, the median becomes the addition of the two middle numbers divide by 2

Example

Find the median of 53, 50, 47, 48, 51, 52, 58, 90, 54, 50.

The teacher arrange the scores in ascending order thus:

Solution

47,48, 50,50, 51, 52, 53,54,58,90

Median = $\frac{51 + 52}{2}$

$= \frac{103}{2}$

$= 51.5$

Again, the teacher tell the students what mode is:

Mode is the number that occurs most in a given set of number. It is the number with the highest frequency.

Example

What is the mode of the following set of scores, 2,2,2,5,7,8,9?

Solution

The number 2, occurred most.

Mode = 2

APPENDIX 7

List showing name of schools in the 9 local government area of Delta North senatorial District.

Anioch South-Ogwasi-Uku

1. Abah-unor Secondary School, Abah-unor
2. Adaigbo Secondary School Ogwashi-Uku
3. Adonte Secondary School, Adonte
4. Comprehensive Secondary School, Ashama
5. Comprehensive Secondary School, Ogwashi Uku
6. Egbudu Mixed Secondary School, Egbudu-Akah
7. Ifite secondary School, Isheagu
8. Isho Mixed Secondary School, Isho Quarter Ubulu-Uku
9. Ejeme secondary School Ejeme-Aniogor
10. Ngwu Secondary School, Azumgwu,
11. Nshiagu College, Ogwashi-uku
12. Nsukwa Grammar School, Nsukwa
13. Okiti Mixed Secondary School Olloh-Ogwashi-Uku
14. Olloh Mixed Secondary School Olloh-Ogwashi-Uku
15. Ubulu-Unior Mixed Secondary School, Ubulu-Unor

Aniocha North-Issele-Uku

1. Azagba Mixed Secondary School, Azagba
2. Boys Model Secondary School, Oniocha-Olona
3. Comprehensive Secondary School Idumje-ugboko
4. Comprehensive Secondary School Oniocha-Uku
5. Ezechima Mixed Secondary School, Obior
6. Ezi secondary Commercial School, Ezi
7. Idumuje-unor Mixed Secondary School,
8. Dumuje-oge Mixed Secondary School, Idumu-ogo
9. Issele-uku Technical College, Issele-Uku
10. Martins College, Issele-Uku
11. Obankpa Mixed Secondary School, Obankpa
12. Okalete Secondary School, Issele-Mkpetime
13. Odiani Mixed Secondary School, Ukwunzu

14. Olona Boys Secondary School, Oniocha-Olona
15. Oniocha-Ugbo Girls Grammar school, Oniocha-Ugbo
16. Ubulubu Secondary School, Ubulubu.
17. Ugbodu Secondary School, Ugbodu.

Ika South-Agbor

1. Abavo Girls Secondary School, Abavo
2. Agbor Technical College, Agbor
3. Agwa-Ewuru Secondary School, Agbor-Ewuru
4. Alidinma Secondary School, Agbor-Alidinma
5. Alisimie Mixed Secondary Commercial school, Alisimie
6. Dein Palace Secondary School, Agbor
7. Ekuku-Agbor Secondary School, Ekuku-Agbor
8. Emuhu Grammar School, Emuhu
9. Ihu-Iyase Secondary School, Agbor-Nta
10. Ime-Obi Secondary School, Agbor
11. Irenuma II Secondary School, Idumugbo, Abavo
12. Jegbefume Secondary School, Abavo
13. Mixed Secondary School, Oyoko-Abavo
14. Obi-Anyima Secondary School, Abavo
15. Ogbemudein Secondary School, Agbor
16. Okpe Mixed Secondary School, Omumu
17. Ozanogogo Secondary School, Ozanogogo

Ika North East-Owa-Oyibu

1. Akumazi Secondary School Akumazi
2. Comprehensive High School, Igbodo
3. Ede Gramar School, Umunede
4. Ekwuoma Secondary School, Ekwuoma
5. Elugu Secondary School, Ute-Enugu
6. Erumu Secondary School, Ute-Erumu
7. Idumuesah Secondary School, Idumesah
8. Mbiri Mixed Secondary School, Mbiri
9. Otolokpo Mixed Secondary School, Otolokopo

10. Owa Secondary School, Owa-Oyibu
11. Owa-Alero Secondary Commercial School, Owa-Alero
12. Owa-Alizomor Secondary School, Owa-Alizomor
13. Owa-Nta Secondary School, Boji-Boji Owa
14. Owere-Olubor Secondary School, Owere-Olubor
15. Umunde Mixed Secondary School, Umunde
16. Ute-Okpu Secondary School, Ute-Okpu
17. Ute-Ogbeje Secondary School, Ute-Ogbeje

Ndokwa-West-Kwale

1. Abbi Grammar School, Abbi
2. Abbi Girls Comprehensive Secondary School, Abbi
3. Community Secondary School, Ogbelei-Ogume
4. Ebendo Secondary School,
5. Emu Secondary School, Emu Unor
6. Eastate Secondary School, Utagba-Unor
7. Ezegbaja Secondary School Utagba-Unor
8. Girls secondary School, Ndemili
9. Girls secondary School, Utagba-Ogbe
10. Isumpe secondary School, Ullohwe-Isumpe
11. Mixed Secondary School, Ogbagu-Ogume
12. Mixed Secondary School, Ugiliama
13. Ndemili Grammar School, Ndemili
14. Mixed Secondary School, Oniocha-Ukwani
15. Obodeti Secondary Commercial School, Emu-Obodeti
16. Ogume Grammar School, Ogume
17. Oliogo Secondary School, Oliogo-Umuseji
18. Utagba-Ogbe Secondary School, kwale
19. Utagba-Ogbe Technical College, Kwale

Ndowka East-Aboh

1. Abala Secondary School, Abala
2. Aboh Secondary School, Abala
3. Afor Secondary School, Afor

4. Asaba-Ase Secondary School, Asaba-Ase
5. Ase Grammar School, Ase
6. Azagba Secondary School, Azagba
7. Basic School, Isselegwu
8. Government Secondary School,
9. Akaria-Obodo
10. Inrede Secondary School, Ibrede
11. Igbuku Secondary School, Igbuku
12. Iniji secondary School, Iniji
13. Ijede-Ame Secondary School, Ijede-Ame
14. Mixed Secondary School, Asiaka
15. Mixed Secondary School, Oluchi
16. Ndam Secondary School, Benekuku
17. Obetim-Uno Commercial school, Obetim-Uno
18. Odugu Secondary School, Ushic Odugu
19. Okpai-Olieze Secondary School, Opai-Olieze
20. Oloa Secondary, School, Oloa-Ossissa
21. Onuaboh Secondary School, Onuaboh
22. Onyah Secondary School, Onyah
23. Ossissa Secondary Commercial School Ossissa.
24. Ossissa Secondary School, Ossissa
25. Umuolu Secondary School, Umuolu

Oshimili South Asaba

1. Asaba Girls Grammar School, Asaba
2. Asaba Mixed Secondary School, Asaba
3. Basic Secondary School, Oko-Anala
4. Nigeri Mixed Secondary, School, Oko
5. Oko Mixed Secondary School, Oko
6. Oko-Ogbele Secondary School, Oko- Ogbele
7. Okwe Secondary School, Okwe
8. Osadenis Secondary School, Asaba
9. Westend Mixed Secondary School, Asaba

10. Zappa Basic Secondary School, Asaba
11. Zappa Mixed Secondary School, Asaba

Oshimili North-Akwukwu-Igbo

1. Akwukwu-Grammar School, Akwukwu-Igbo
2. Basic Secondary School, Ikah
3. Ibusa Girls Grammar School, Ibusa
4. Okpalani Secondary School, Okpanam
5. Ugbulu Secondary school, Ugbulu
6. Ukala-Okpunor mixed secondary school, Ukala-Okpunor
7. Illah Grammar school, Ilah
8. Okpanam Comprehensive High School Okpanam
9. Atuma-Iga Mixed Secondary School, Atuma
10. Ebu Grammar School. Ebu

Ukwuani-Obiaruku

1. Akashiede Girls Secondary School, Obiaruku
2. Amai Secondary School, Obiaruku
3. Boys secondary School, Obiaruku
4. Ebedei Secondary School, Ebedei
5. Eziokpor Secondary School, Eziokpor
6. Ezionum Secondary School, Ezionum
7. Mixed Secondary School, Akoko-Ebede
8. Obiaruku Grammar School, Obiaruku
9. Umuebu Senior Secondary School Umuebu
10. Umuaja Secondary School Umuaja
11. Umukwata Secondary School, Umukwata
12. Umutu Mixed Secondary School, Umutu

APPENDIX 8

T-Test

[DataSet1] C:\Users\user\Documents\Ofuonyebuzor.sav

Group Statistics

	Academic Achievement	N	Mean	Std. Deviation	Std. Error Mean
Teaching Method	Guided Discovery	160	73.4562	11.12584	.87957
	Lecture Method	160	46.0750	6.48030	.51231

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Teaching Method	Equal variances assumed	58.931	.000	26.900	318	.000	27.38125	1.01790	25.3758	29.38392
	Equal variances not assumed			26.900	255.748	.000	27.38125	1.01790	25.37672	29.38578

T-Test

[DataSet1] C:\Users\user\Documents\Ofuonyebuzor.sav

Group Statistics

	Academic Achievement	N	Mean	Std. Deviation	Std. Error Mean
Guided Discovery	Male	83	73.3253	12.84534	1.40996
	Female	77	72.8182	9.27181	1.05662

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Guided Discovery	Equal variances assumed	16.571	.000	.284	158	.776	.50712	1.78300	-3.01448	4.02872
	Equal variances not assumed			.288	149.195	.774	.50712	1.76194	-2.97446	3.98870

T-Test

[DataSet1] C:\Users\user\Documents\Ofuonyebuzor.sav

Group Statistics

	Academic Achievement	N	Mean	Std. Deviation	Std. Error Mean
Lecture Method	Male	77	47.5714	7.04203	.80251
	Female	83	44.6867	5.60472	.61520

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Lecture Method	Equal variances assumed	8.302	.005	2.877	158	.005	2.88468	1.00266	.90434	4.86502
	Equal variances not assumed			2.853	145.121	.005	2.88468	1.01119	.88613	4.88324

T-Test

[DataSet1] C:\Users\user\Documents\Ofuonyebuzor.sav

Group Statistics

	Academic Achievement	N	Mean	Std. Deviation	Std. Error Mean
Guided Discovery	Urban	93	74.1720	12.45568	1.29159
	Rural	67	53.3433	12.99015	1.58700

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Guided Discovery	Equal variances assumed	.556	.457	10.250	158	.000	20.82876	2.03216	16.81506	24.84246
	Equal variances not assumed			10.179	138.726	.000	20.82876	2.04616	16.78306	24.87446

T-Test

[DataSet1] C:\Users\user\Documents\Ofuonyebuzor.sav

Group Statistics

	Academic Achievement	N	Mean	Std. Deviation	Std. Error Mean
Lecture Method	Urban	93	68.6452	15.73880	1.63204
	Rural	67	49.0000	7.26553	.88763

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Lecture Method	Equal variances assumed	48.541	.000	9.507	158	.000	19.64516	2.06638	15.56387	23.72645
	Equal variances not assumed			10.574	137.684	.000	19.64516	1.85780	15.97165	23.31867