ENHANCING THE RETENTION CAPACITY OF BASIC SCIENCE STUDENTS THROUGH THE GUIDED DISCOVERY AND DIDACTIC INSTRUCTIONAL METHOD

BY

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APPROVAL

I hereby certify that I approve this work as being adequate in scope and quality for the partial fulfillment of the requirement for the award of the B.Sc (Ed.) Integrated Science.

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CERTIFICATION

We, the undersigned certify that this study was carried out by **UVAH-AFIMONI TINA UJIRO** of the Department of Educational Psychology and Curriculum Studies, University of Benin, Benin City. We therefore approve the research work as adequate in scope and quality for consideration in partial fulfillment of the requirement for the award of B.Sc (Ed.) Integrated Science.

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DEDICATION

This project work is dedicated to the Almighty God, my heavenly Father, Jesus Christ, my Saviour and the Holy Spirit, the source of my joy and strength.

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ABSTRACT

This study examined the guided discovery method as an instrument for enhancing students' retention capacity in basic science. Relevant literatures from books, journals, lectures, textbooks and others were reviewed to find out the opinions of other authors regarding the effectiveness of guided discovery method and its supremacy over the didactic method. The main objectives were- investigating the extent to which the guided discovery method will enhance the retention capacity of basic science students, compare the retention capacities of male and female students taught with the guided discovery method and to compare the mean scores of basic science students taught with guided discovery method and the didactic method in a retention test.

The population of the study comprised of all junior secondary school students in Egor Local Government area of Edo State. Out of these schools, one was chosen, having two intact classes of JSS III basic science students, and this constituted the sample of the study. A 50-item achievement test was administered to the two treatment groups (the experimental and control groups) before and after the treatment and the scores obtained were analysed using t-test and analysis of covariance (ANCOVA).

The findings indicated that the guided discovery method enhances the students' retention capacity than the didactic method. Also, retention rate was lower for girls than for boys. Based on the findings, it was concluded that the guided discovery teaching method should be applied in teaching basic science.

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CHAPTER ONE

INTRODUCTION

Background to the study

As a matter of policy, science education has been given considerable attention in Nigeria since the National Curriculum Conference in Lagos in 1969. This attention followed Nigeria's realization of the role of science and technology in the development of any society. The yearning for quality and effective instruction delivery has been a long standing objective of science education. The emerging concern for the poor performance of students in school science and its resultant consequence on the production and development of future scientists, engineers and technologists has to be acted upon with a sense of urgency before it aggravates any further.

Also worthy of note is the fact that teaching of science subjects in Nigerian schools has continued to generate tremendous attention among parents, teachers, scholars and policy makers (Ekuri and Asim, 2008). The attention arises from the fact that the attainment of secondary school students in basic science and other science subjects has continued to degenerate over the years

(Ajewole, 1990 and WAEC annual report, 1999, 2012). Thus, efforts are continuously made to improve the quality of science instruction. Emphasis has shifted from the learning of 'hard facts' which is only meaningful to the scientific community, to the acquisition of knowledge of science in terms of concepts. This type of knowledge acquisition provides one with the necessary foundation for an objective mode of thinking, which enhances the application of what is learnt whenever the need to do so arises.

Basic Science is a subject taught in Lower, Upper Primary and Junior Secondary Schools. Basic Science (formerly Integrated Science) in Junior Secondary schools is a course of study which is devised and presented in such a way that students gain the concept of the fundamental unity of science, the commonality of approach to problems of a scientific nature and are helped to gain an understanding of the roles and functions of science in everyday life and the world in which they live. (Mohammed, Ahmed, Liman, Bello, 2008). Agbo(2008) stated that Basic Science is the bedrock to understand and advance studies in science, technology and engineering.

The objectives of Basic Science education, according to the National Policy on Education (2005), include to

1. Lay a sound basis for scientific and reflective thinking.
2. Give the pupils/students opportunities for developing manipulative skills.
3. Provide the pupils/students with basic tools for further educational development.

And according to NERDC (2007) the objectives of the New Basic Science curriculum is to enable students

1. Develop interest in science and technology.
2. Acquire basic knowledge and skills in science and technology.
3. Apply their scientific and technological knowledge to meet societal needs
4. Take advantage of the career opportunities offered by science and technology.
5. Become prepared for further studies in science and technology.

The Basic Science Education programme occupies a unique position in the school curriculum. Besides the fact that it equips students with the skills necessary to build a progressive society, it also forms the bedrock upon which further science studies rest. A solid foundation in Basic Science would directly or indirectly contribute to the much desired scientific and technological advancement of the Nigerian society, just as a poor foundation may also have negative consequences.

Consequently, science instruction has become a focus of research for two or more decades. Research on instruction delivery strategies have been undergoing an overturn of its own to promote meaningful science teaching and learning in schools. Contemporary accentuation centers on interactive, minds-on and hands-on learning through constructivist teaching approach. The Federal Republic of Nigeria, FRN (2004) in its National Policy on Education stipulates that Nigerian education cannot rise above its teachers. Therefore, the success of education depends on the quality of teachers. (Danmole and Femi-Adeoye, 2004).

The impact of teaching plays a major role in the learning outcomes in all tiers of education. This is more important in generating professionals. Its effectiveness depends on how much has been received by the students or the target audience.

The poor achievement of learners in Basic Science has been variously explained. The factors that negatively affect Basic Science achievement include student background problems, students' lack of interest and/or negative attitude towards Basic Science, teacher-related factors like poor teacher preparation, inadequate qualified Basic Science teachers, inadequate instructional materials and application of poor teaching methods. Science teachers, generally, and Basic Science teachers particularly, need to be conversant with modern innovative teaching strategies and be encouraged to employ these strategies in their teaching.

It has been observed that Basic Science teachers mainly adopt instructional strategies that are mainly teacher-related and do not encourage deeper student involvement. In the conventional classroom, surface approaches are very common. Most students have adopted a surface approach to learning in terms of attending classes, reviewing notes and doing exercises. The students are the passive recipients of information already acquired by the teacher. Most conventional Basic Science classes aim to make mastery of the textbook, to complete textbook assignments and are examination oriented. Since the students are taught using the chalk-and-talk method, they are unable to get aware of better knowledge in learning Basic Science, much less building up their retention capacity.

Teaching is an interactive process through which knowledge is and skills are shared with a view to improving students' understanding and ability to manipulate the social, economic, political and physical environment to enhance their survival. (Flanders, 1970, Brown, Oke& Brown, 1982). As noted by Ayot and Patel(1992), the main objective of teaching is to bring about desirable learning in students. In this regard, students are expected to develop appropriate knowledge and skills which are necessary for solving problems and improving human life. In most cases, the teacher initiates communication and influences students to think in a certain way as guided by the syllabi.

In order to achieve the goal of teaching and learning, changes have occurred in curriculum development and formulation of models of teaching has been done. One of such kinds is the guided discovery instructional method. This method has its basis in the constructivist learning theory which asserts that learning occurs as learners are actively involved in the process of meaning and knowledge as opposed to passively receiving information. Constructivism, drawn from cognitive and behavioral psychology, is a theory that states that the individual learner processes stimuli from the environment and the resultant cognitive structures that the learner builds produces adaptive behavior. As noted by Roblyer (2006), constructivists believe that knowledge is generated by students through experience-based activities rather than directed by instructors. Advocates of the constructivist approach suggest that knowledge is generated by students through their own efforts in their own efforts in a regulated manner. Cummings (2007) found that when constructivist approaches are employed in learning, students show an improvement in their academic performance.

The teacher's role is facilitative, coaching, simulative and proactive in ways that allow the learner to engage in critical and creative thinking, analysis and synthesis of ideas during the learning process as the teacher assumes the role of a teacher provides learning process as the teacher assumes the role of a co-learner. The constructivist teacher provides learning tools and activities that encourage problem-solving and inquiry-based learning activities with students formulate and test ideas, draw conclusions and inferences and convey their knowledge in a collaborative learning environment. (Sunderman, 2006).

The guided discovery instructional method can be considered as any procedure in which the teacher, by posing appropriate problems encourages students to think for themselves and become more independent. The major proponent of the discovery approach is

Bruner (1961, 1966). He agreed that learning that learning involves the active processing of information and that it is organized and constructed in a unique way by each individual. He stressed that knowledge about the world is not simply poured into the individual; instead, individuals attend selectively to the environment. Much learning occurs through discovery during exploration that is motivated by curiosity. He views learning to be effective if the learner is given the opportunity to discover the solutions himself and that any information provided/presented and may not apply it to problem solving.

Depending on the degree of involvement of the teacher, discovery may be classified as guided or open. The guided discovery is a situation in which the learner is presented with problems and at the same time given a number of cues, hints and instructions that could guide him solve the problem. In this approach, the teacher teaches the major concepts on solving problems. The guided approach is recommended for the teaching of science at the primary and secondary levels of education (Ibanga, 2005).

In the Basic Science curriculum, the guided discovery method of teaching is advocated at the Junior Secondary School level. This is to promote learning by doing and skill acquisition for further use and for the achievement of self-reliance for the students on leaving school. Self-reliance involves optimal utilization of local resources with well coordination of sustainable development (Etubon and Udofia, 2009). It is a well-known fact that what one finds out for himself, he hardly ever forgets.

The didactic instructional method, also known as the lecture method of teaching is a teacher-centered, student-peripheral teaching approach in which the teacher delivers a pre-planned lesson to the student with or without the use of instructional materials (Nwagbo, 1999). According to her, in using this method, the teacher 'talks about the subject' while the students 'read about the subject'.

This instructional method is teacher-centered. What this means is that it is one of the traditional instructional methods where the teacher is at the centre of classroom activities including explanations and discussions (Ahmed and Aziz, 2009). The teacher-centered approach is behaviorist in nature. Teacher-directed learning follows the instructive approach which involves careful and meticulous planning of the procedure and purposeful instructional procedure employed by the teacher. Under such conditions, students have a definite and fixed perception of their roles as listeners while teachers are expected to be the talkers and custodians of knowledge. This implies that students' active participation is minimal until the teacher authorized them. Tanner (2009) found that teachers dominated classroom talk and students talk only when called upon to answer questions.

Ogunniyi pointed out that in spite of its limitations, the didactic method, otherwise known as the lecture method has most frequently been used in the teaching of science. Furthermore, Oraifo noted that in Nigerian schools, instructional methods in the regular classroom has been teacher-centered and characterized by the teacher talking most of the time while students listen, take down notes and occasionally ask questions. The result of this is that cramming is encouraged because they are told to ‘take it as it is’ whether they understand it or not. And sadly, whatever is crammed hardly ever exceeds the examination period, and that is if they ever recollect at all. Besides, students find it hard to apply knowledge that was not first understood before being committed to memory.

According to UNESCO(1975) and Osborne (1997),basic science should be relevant to real life and experience of the learner. There is need to change from closely directed learning of facts to conceptual understanding, application of acquired knowledge and skills to help solve emerging problems. Students leaving secondary school should be able to apply scientific knowledge learned and solve some of the problems encountered in everyday life (Rose, 1971). Nelson (2000) posits that there is a relationship between motivation, cognitive engagement and conceptual change. An effective teaching approach should therefore utilize a wide variety of teaching methods to enhance learners’ motivation and actively involve them in the learning process. Expository approaches cannot stand up to the challenges of new demands and objectives of basic education; hence the need to explore new teaching approaches (UNESCO, 1986).

Teaching approaches that would involve learners would likely lead to higher motivation and meaningful learning compared to those where they remain passive. UNESCO suggests including teaching approaches which are inquiry/discovery based and which requires some form of problem solving. These approaches have the capacity to motivate learners and actively involve them in the active process.

Mills (1991) argues that a teaching approach that a teacher adopts is a strong factor that may affect a learner's motivation to learn, and hence, has a direct impact on the resultant cognitive gain. Students, most especially, are able to recall bits of information they are interested in. In recent years, have science educators have used the constructivist approach to enhance students learning (Trowbridge and Powell, 2004). According to Good and Brophy (1995), in constructivist teaching, learners are not seen as just assessing information, but also constructing meaning. Aslop and Hicks (2001) point out that learning of science is essentially an active process.

Instructional methods influence achievement of students in education. While appropriate methods enhance learner achievement, inappropriate approaches stifle knowledge retention and application.

There is empirical evidence to show that instructional methods adopted by teachers influence learners achievement significantly. (Dunn,1983; Chang, 2010). Consequently, it is important for teachers to align their instructional methods with needs and preferences of students to enhance effectiveness of the process in terms of learning achievement.

Statement of the problem

The academic performance of Junior Secondary School students in Basic Science and other science subjects has been an issue of concern to parents, teachers and even the government. Investigations made by researchers have identified numerous possible factors responsible for the state of affairs and despite all efforts to improve students' academic performance, results still remain poor. It has been observed, unfortunately, that the high rate of failure is attributable to students' capacity of retention, which is very low. The interest of the study therefore is to determine the extent to which the guided discovery instructional method will enhance the retention capacity of basic science students.

Purpose of the study

Several moves have been made to improve the quality of science teaching (and ultimately, students' performance) through the development of radical science curricular and teaching methodology (Isa, 2007). These led to the development of a suitable curriculum which Abdullahi (1982) called "Activity-oriented curriculum". This curriculum emphasizes pupil-centered activities as the right approach to learning science. To implement this new curriculum, the Federal Government of Nigeria, in its policy on education (2004) de-emphasized the memorization and requisition of facts which are common in our schools, but instead, emphasized practical, exploratory and experimental methods of teaching which can lead to the sustainable development of our dear country, Nigeria.

Unfortunately, Nwagbo (2008) and Ajaja (2009) noted that teaching is still done predominantly by the lecture method while learning of Basic Science involves listening, copying and cramming of notes. Transfer of learning is at a very low ebb, leading to the production of half-baked graduands (Nwagbo, 2008). In order to bring about improvement in the performance of basic science students in particular, and science students in general, effective teaching must take place.

For this to be made possible, the teacher must stimulate, encourage and maintain active participation of the students through the selection of appropriate teaching methods. This would require a balance between what is taught and how it is taught. Thus, successful teaching does not depend only in the teacher's mastery of the subject matter, but also the teaching method employed. Hence, Ogbonna (2008) opines that one of the most influential factors in teaching is the teacher's mode of teaching. Hence, this study examines the effects of guided discovery instructional method and the didactic instructional method on the retention capacity of Basic Science students.

Specifically, this study is designed to

1. Investigate the extent to which the use of guided discovery instructional method will enhance the retention capacity of Basic Science students
2. Compare the achievement of students when taught with guided discovery and didactic instructional method.
3. Compare the retention levels of male and female taught with the guided discovery instructional method.
4. Investigate the extent to which the guided discovery instructional method will enhance the academic achievement of Basic Science students.

Research questions

This study is designed to find answers to the following questions that were raised for this study.

1. Is there any significant difference in retention capacity of basic science students taught with guided discovery and those taught with didactic method?

2. Is there any significant difference between the scores of male and female students taught with guided discovery method?
3. Is there any significant difference between the means scores of the experimental and control groups in basic science retention test?

Significance of the study

The findings from this study would be beneficial to many people through improving the poor performance of Basic Science students. These people include the students, teachers, curriculum planners, textbook writers, government and the society at large.

Teachers would benefit greatly from this study as they would be exposed to the relevance of the guided discovery teaching methods and would minimize their use of the lecture method. Improved teacher competency is an important consequence of this study. The teacher becomes more resourceful and creative and instruction would become more lively and interesting.

The students, themselves would be able to practically engage in scientific thoughts and processes through discovery. They would see themselves as being capable and not failures. Their interest would be aroused; creativity and retention would greatly increase. Their intuitive skills and I.Q would also develop visibly.

This study would also benefit curriculum planners by enabling them include more student-oriented activities when reviewing the curriculum. Also, the goals of the curriculum planners would be redirected towards more acquisition of performance skills in basic science than on acquisition of performance skills in Basic Science than on acquisition of performance skills in Basic Science than on acquisition of knowledge.

Finally the society will benefit from this study because if the results from the study help to improve students' achievement, interest and retention level, then the subject and its allied courses (Physics, Chemistry, Biology, Pharmacy, etc.) will be studied by many students institutions of higher learning. If students study Basic Science then the needed technological development the country needs would be accomplished.

Scope of the study

The scope of this study encompasses all Junior Secondary Schools in Edo State.

Research hypothesis

The following research hypotheses were formulated to direct this study.

1. There is no significant difference in retention level between Basic Science students taught with guided and didactic method.
2. There is no significant difference in retention level between female and male Basic Science students taught with guided discovery method.
3. There is no significant difference between the mean scores of the experimental and control groups in a retention test of Basic Science.

Limitations of the study

Quite a good of amount of literature has shown a greater interest in the achievement and retention effects of the strategy in many subjects –the arts, social science and science subjects like Physics, Chemistry and Biology but none had specifically treated Basic Science. Because of this, not many literature were available for review.

This literature was restricted to third year students at the Junior Secondary School level in Egor local government area of Edo State, Nigeria. Apart from these, only one unit of the Basic Science textbook was taught.

Definition of terms

1. Guided discovery instructional method: This method can be considered as any procedure in which the teacher by posing

appropriate problems encourages pupils to think for themselves and become more independent.

2. Didactic instructional method: This is also known as the lecture method is a teacher-centered, student-peripheral teaching approach in which the teacher delivers a pre-planned lesson to the students with or without the use of instructional materials.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

A research for studies that relate to instructional strategies has shown that a good number exist. In relation to this study, attention has been drawn particularly to the following areas:

1. Concept of discovery as an approach in science teaching.
2. Theoretical frame work of the guided discovery instructional method
3. Constructivism and the guided discovery learning design
4. Claims and criticisms of the discovery method
5. The didactic instructional method.
6. Related studies to students' performance and retention
7. Behavioural objectives in
8. the science approach
9. Science concept in learning.

Concept of discovery as an approach in science teaching

Schulman and Tamir (1973,P. III) believe that the concept of discovery has been replete with ambiguities in both research literature and the more inspirational writings of science education. In one of their descriptions, they referred to the discovery method as an independent variable – which includes methods, materials or media of instruction, the character of teachers and so on. In this sense, the discovery method is known as the mode of instruction that is usually contrasted with other forms of instruction, including the traditional or didactic or teacher-centered methods.

Learning by discovery requires certain prerequisites that will bring about the learning of some concepts, principles and/or attitude. In relation to this, they (Shulman and Tamix) said that it should be seen as "necessary to ensure that the learner integrates the material learning into his cognitive structure, develop the capacity to transfer what has been learned, to novel problem solving and acquire a positive concept of him as an autonomous problem solver."

Surely, a learner who is equipped with the necessary prerequisite information and at the same time can develop the capacity to transfer what has been learnt into dealing with subsequent problems indicates the attainment of instructional objectives and consequently, achievement in learning.

Sund and Trawbridge (1973, pg 62) believe that a discovery activity is a lesson designed on such a way that a student, through his own mental processes discovers concepts and principles; and that for a student to make discoveries, he has to perform certain mental processes like observing, classifying, measuring, predicting, describing, inferring etc. For example, the students may discover what cell is (i.e. for a concept of all) and later on, he may discover scientific principle that cells only come from cells.

Vagne (1977, pg164) maintained that the discovery method is only possible when the learner is equipped with pre requisite knowledge of rules of the problem. For example, he said that college students who were told only the goal of the problem solving for the pendulum problem without being reminded of the subordinate rules and without “direction’ were unable to solve the problem. Arguing in the same line with Gagne, Abdulahi (1982) wrote that the teacher can give some kind of guidance, if need be, and that the method is facilitated when a pre-activity discussion can precede the actual discovery so that the students will understand the expected outcome of the activity.

Gagne's instructional procedure begins from simple to complex. That is in contrast to that of Bruner in which learning by discovery begins from complex to the simple mechanisms. Ogunniyi (1986, pg.61) described this as "a process analogous to teaching someone to swim by throwing him into a deep pool of water. The assumption is that he will learn the necessary skills because he needs them. The basis of his is rather tenuous. Any wonder why a large number of "casualties" have occurred under many of the new science and mathematics problems, many students were literally drowned by the very programmes designed to help them in science or mathematics.

Ogunniyi's observation calls for the attention of curriculum planners and specialists in Science and Mathematics education, particularly at the secondary school level.

In science the aim is not only the description and inculcation of the body of knowledge but the encouragement and guidance of the processes of discovery by the students. In line with this, Merwin (1776, p74,389) described it as a process by which people engage in learning by finding out for themselves. Novak 91976, pg 502) referred to discovery method as a creative ability and that it involves some form of novel product or solution.

As an operational definition, Ogunyemi (1973, pg. 335) believes that in order to mitigate the fuzziness surrounding the use of the term “discovery method’; it would be subsumed under the more generic term “student – centered method”.

Theoretical Framework of the guided discovery instructional method

Brunner

One of the major proponents of the guided discovery instructional method is Brunner. Jerome S. Burner views learning to be effective if the learner is given the opportunity to discover the solutions to problems by himself. He is of the view that if information is provided or presented to the individual, the individual could only recall the information the way it was presented and not apply it to problem solving. Bruner sees learning as an active process in which learners construct new ideas or concepts based on past or present knowledge. Infact, the learner selects and transforms information, constructs or formulates hypothesis and makes decisions based on a cognitive structure. Cognitive structure provides meaning and organization to experiences and allows the individual to go beyond the information given (Bruner, 1973).

As regards impacting knowledge to the students, Bruner advocates that the teacher should try and encourage the students to discover the principle or answers by themselves. He also advocates active dialogue between the teacher and the students. The teacher should translate the information into an appropriate format so as to suit the learner's current state of understanding. Bruner is of the view that the school curriculum should be organized in a spiral manner so that students can build upon their previous knowledge.

According to Brunner (1960), a theory of instruction should be based on the following four (4) principles.

1. Predisposition towards learning i.e. learning should be concerned with the experiences and contexts that make the students willing and ready to learn.
2. The way in which a body of knowledge can be structured so that it can be most readily grasped by the learner. This implies that learning must

be structured so that it can be easily grasped by the learner (spiral organization).

3. The most effective sequences in which to present material i.e. learning should be designed in such a way that students can go beyond the information given.

The implication of these principles to education include the following

1. Teaching should be interesting in actor to ensure proper retention of learned materials and for effective information processing.
2. Learning should be made to have bearing with everyday life experiences.
3. In preparing the learning process, the teacher should ensure that there is effective re organization of concepts so as to ensure easy and sequential flow of information.

Piaget

Another proponent of the guided discovery approach is Jean Piaget (1896-1980). Piaget designed a proper framework to understanding the structure, functioning and development of the cognitive network of the human mind.

He is of the view that cognition is developed through the construction of schema (i.e. abilities/potentials) and the process of assimilation and accommodation. He maintained that the development of intelligence is based on environmental experiences. In other words, what is available to an individual in terms of his schemas (potentials) decides how he will respond to the stimuli present in his physical or social environment.

One of the major contribution of this theory lies on its analysis and suggestion of the optimal conditions for an individual's learning and development by introducing the course of assimilation, accumulation and equilibrium.

This theory also advocates that children should be allowed to experience with materials in order to accommodate new understanding and to acquire new learning by themselves. In addition, the teacher should organize discovery learning rather than teaching or telling each and every part of information to students; an environment in which there are variety of experiences for self or discovery learning rather than teaching or telling each and every part of information to students. An environment in which there are variety of experiences for self or discovery learning should be provided to the students. The Piagetian theory emphasizes the need for individualization in education. It has advocated the need for the child-centered education, by emphasizing that educational experiences should be built around the learner's cognitive structure.

Constructivism and the guided discovery learning design

The constructivist learning theory is based on the belief that learning occurs as learners are actively involved in the process of meaning and knowledge construction as opposed to passively receiving information. Learning always builds up on knowledge that a student already knows (schema). The constructivist theory of education was developed by Lev Vygotsky, a psychologist and educator born in 1896. Vygotsky's theory was based on the principles of social constructivism.

Constructivist approach to learning asserts that children have their own way of thinking they should be treated as individuals and should have opportunity to work with others and learn through observation, talking and group work. Students have skills that have not fully emerged but have the potential to be fully developed particularly through interaction with others.

Constructivists believe that students should be engaged in active learning. The teacher's role is to assist the students in what they are doing. They should be given the opportunity to explore a problem, try out solutions, build on this new knowledge to make adjustments and evolve new solutions, all having an input and actively discussion and developing ideas. The constructivists support what is called 'scaffolding learning' i.e. as a child learns new things, he should be given lots of support. This can be done through the use of world banks, writing frames, concrete material and questioning techniques. Teachers should provide stimuli and prompts, varying their presentation. As the student's learning develops, the scaffolding is removed. The way on which new ideas are introduced and presented to students influences the way in which they are retained. Instruction must be structured so that it can be grasped easily and presented in a way that involves children's experiences and contexts so that they can build on their knowledge and are willing to learn.

Another major tenet of the constructivist approach is the spiral curriculum student's prior knowledge needs to be developed and built upon and as such, ideas should be introduced at different stages and levels-the spiral curriculum "which enables a continuous development of knowledge. Reintroducing concepts already learnt helps students reach a deeper level of understanding. Teachers should help students to develop what they already know and use their previous knowledge to solve problems, to explore and to question. This approach says teachers must be facilitators of their student's learning; not transmitting knowledge, but encouraging students and stimulating their ideas.

Claims and Criticisms of the discovery method

Current literature in education abounds with reference to the merits and demerits of the discovery method. The proponents report phenomenal success while the opponents counter that these strong claims are exaggerated.

Reviewing past studies of some leading advocates, merwin (1976) reported that students learn just as many facts and actually display more interest, enthusiasm and sense of relevance when compared to didactic instructional approach. Bruner (1961, pg 20-23) believes that discovery teaching increases the intellectual potency, retention, transfer, memory, motivation and organizational ability of the learner.

Critics of discovery approach to point that there is little proof that it actually produces all it claims. One of the most cited individuals on this field is an American psychologist – David Ausubel. Defending the didactic method, Ausubel (1933,pg 223-237) argues that when greater learning and subsequent transfer occur using discovery, it is because a greater effort has been expanded by both the teacher and the learner. And that discovery is too time consuming.

In all, it should be noted that the point being made is that the discovery method in isolation could be misleading as students, when left to discover for themselves might stray away from the subject matter. This is where the teacher is expected to provide guidance. The guided discovery method is the method that can be applied as that the teacher can give some kind of guidance when the need arises; and the method can be facilitated when a preactivity discussion can preceed the actual lesson so that the students will understand the expected outcome of their activity.

The didactic instructional method

Writing on the theory of teaching, Smith (1970, pg3) contends that teaching is so varied, so complex, so fluid as almost to defy any description whatever and that it certainly does not correspond to the concepts of methods set forth in treaties on the subject. And that when we speak of methods of teaching, we are speaking not about realities but about the picture we have built up out of ideas borrowed from psychology and philosophy.

Because of these complexities in the nature of teaching, the phrase “didactic method of instruction” is normally given different names by different eminent scholars. It includes names such as lecture’, traditional, expository; ‘teacher-centered’, dogmatic,’ vicarious’,and so on.

In the encyclopedia of Educational Research (4th ed.), it is defined as that in which the teacher communicates orally in one – way direction, for the most part, the knowledge and ways of behavior to be acquired.

The didactic method is a teacher-centered, student-peripheral teaching approach in which the teacher delivers a pre-planned lesson to the students with or without the use of instructional materials. (Nwagbo, 1999). According to her, in using this method, the teacher "talks about the subject" while the students "read about the subject".

Sund and Trawbridge (1973) maintained, that an experienced teacher can use it effectively for 10 to 20 minutes particularly if he/she is using several visual aids such as chalk ward, overhead projector, models or apparatus. The example given was how to use a microscope. That it may work well especially if the students have microscopes before them and are encouraged to locate the parts being covered in the lecture. But they earlier on, noted some of the limitations as "many students tune the teacher out, become bored, restless and eventually cause discipline problem". Added to this is that the attention span of secondary school students for a didactic session is at best short.

Referring to the didactic method as learning from listening, Ebell in the Encyclopedia of educational research, (4^{th} ed)"The learning from listening consists of active participation through anticipating or covertly predicting the flow of the lecture's discourse or argument. When these implicit responses are confirmed, that is, when the listener comprehends, he is reinforced and the probability of behaving in a certain way is increased".

Didactic methods could be described as those that were once useful, but now when all can read and books are numerous, lectures are unnecessary. For example, in a situation when attention fails, and a part of lecture is missing, it is lost and there would be no going back. Surely, this forms a limitation on the part of the instructional approach on economic ground, it can be used because the learner teacher ratio can be extremely large. In relation to flexibility, the expository method can be easily adapted to the audience, subject matter, available time and equipment. In addition to these are the questions of spontaneity and adaptability to teacher-schedule, in that, the teacher cannot always plan ahead sufficiently to have material reproduced, and sometimes, sheer inefficiency. (Encyclopedia of Educational Research, 4th ed.)

A good lecture method needs to be well introduced, organized, delivered in a clear and confident voice, varied in emphasis and intonation, aptly illustrated with cogent examples, accompanied with abundant "eye contact" with the listener, appropriately summarized, and son on.

In addition to describing the didactic method as being traditionally employed in school for verbal presentation of ideas, concepts, generation of fact, whose objective is to stuff the students with information, Abdulahi (1982) said that t5he method can be used in conjunction with other instructional strategies such as 'demonstration', discussion' and 'discovery'- the earlier note that among the short comings of the system of approach to learning are its inability to meet different needs of pupils and the fact that it encourages role learning and regurgitation without necessarily aiding understanding.

Gorden and Gross (1978,pg. 151) wrote: 'In the lecture method, the teacher presents a body of knowledge to students with minimum of interactions; student's responses and enquires are of classifying nature and do not play a meaningful role in determining the direction the teachers will pursue".

This explanation is in line with that of Ogunyemi (1973) who said that the didactic teaching is a method of instruction in which the teacher does most of the talking and students do the listening, and that in its broadened firm, it includes the fact that the teachers finds out most of the relevant pieces of information on a topic and give this information to the students.

Mani (1983) believes that lecture falls on a continuum, starting from the highly formal (teacher's side) to the most informal (the learner's). And th different forms of lectures on a continuum can be arranged-formal lectures; illustrative lectures, lectures that accompany demonstration, reading out brief period from source materials, lecture modified to allow students' participation, lecture teaching towards conversation and brief formal explanation.

The preceding paragraph indicates that the didactic method cannot exist independent of other instructional approaches.

Related studies to students' performance and retention

Method by which science had been taught in schools since 1900 encounters some formidable difficulties (Jenkin 1980). According to him, the differences between teaching methods resides on the role ascribed to, and the emphasis placed upon such common methodological elements is classroom discussion, laboratory experimentation or class demonstration, and so it is not always possible to differentiate sharply one method from another. Mervin (1976) wrote on research studies representing elementary, secondary and college levels that were to find solutions to such problem as:

i. Can the inquiry method generate the kind of cognitive and affective outcomes necessary for citizenship in a complex world?
ii. Is inquiry effective with diverse students audiences?
iii. Will all teachers be capable of employing inquiry?

In response to the first question, more than forty experimental studies were carried out. And that eight(8), using a different type of inquiry device reported no significant difference. In subject achievement between groups taught by traditional method and those taught by inquiry three (3) found subject achievement slightly higher in inquiry group; and six other reporting collusions favourable to the inquiry method were difficult to assess because instrumentation and statistical methods have been detected.

He also wrote that most of the studies that were in measure knowledge potential of inquiry had other associated learning outcomes, such as cognitive skills and abilities, or effective development, six reported no significant differences between treatment and control groups on measures of critical thinking ability; five reported results favouring inquiry as a teaching method to generate higher cognitive operations, inquiry skills, and critical thinking. And that all reports referring to affective outcomes of inquiry process had positive results. In conclusion, he maintained that upon cursory inspection, it would appear the inquiry method produced distinctive advantages in the affective domains, but added that most of the studies reported clinical observations, and completely omitted any reference to the validity of the instrument employed.

With reference to the heterogeneous students' audiences, be reported that research was far from conclusive and argued that although it has been demonstrated that age (grade level) is not a delimiting factor, there is the need for more extensive search regarding mental ability, psychological disposition and socio-economic status as learner variables. In answering the third question, studies related to teacher style, have found that students have more success on divergent questions, critical thinking tests.

In a study carried out by Shavelon and Munger (1970) to test the relative effectiveness of an Individualized Secondary Science Instructional system against a traditional self-contained classroom Approach, they used 96 55. The SS were randomly distributed into four groups: A_1 & A_2 (with 24 students each) received instruction via teacher – slide- mediated presentation while group B (also with 24 students) received same instruction vice self – placed presentation. A no – treatment control group (N-24) constituted the fourth group.

Analyzing the results, they found that quizzes 1 & 2 demonstrated no significant difference between groups A_1 & A_2 and B. The post – test demonstrated that group B performed significantly better in both achievement (P<.01) and time (P <-01) than did groups A_1 and A_2 – which performed significantly better than the control group (P<01). In the end, they concluded that although no significant differences were found between self-paced and automatically paced-subjects, based on the evidence before them, it was hypothesized that system B would prove more effective in teaching fundamental biochemistry to high school biology students that system A_1.

In a research purported to answer the questions.

i. Which method, the inductive or deductive will produce significantly higher mean scores on recognition and transfer criterion measure administered immediately after termination of instruction and two week later? And
ii. Will there be interaction involving ability, sex and method factors?

Rizzato (1970) suggests that the deductive procedures results in greater initial learning and retention, while discovery experience supplemented by guidance in the firm of prompts or verbal cares invariably facilitates greater transfer of learning.

On sex factor, representing a comparison between males and females averaged over the treatment and ability levels, the female were superiors to males on all but the recognition variable of the immediate criterion. Means for the total score variable favored female 55, 34.01 to 31.93 on the immediate test and 33.51 to 30.10 in the delayed criterion. He concluded that superiority of inductive treatment was independent of ability or sex factors on the basis of immediate criterion.

In an investigation involving ninety six (96) form four students from four post –primary schools in Kano State, Nigeria, Taylor (1976) randomly divided each group into two one received the discovery teaching method and the other got the traditional (expository) method. He had initially prepared booklets that explain the different methods and test presentation. That after teaching, each group completed a short test which required them to write the relevant meaning beside each new word. And without prior warning, the tests were read ministered as a check on retention after 3 weeks.

In his findings, he reported that the students showed consistently better performance with the traditional method. He also noted that reversal advantage was not observed i.e. The students sampled performed better on both the immediate and delayed tests. He replicated the study giving the same task to two similar groups of children (n=50 each). This findings were similar to the previous one because the traditional method was found to be more effective; rote learning experience, he argued, as positively related to the children's performance and the facilitation effect of rote learning is greater when the children are asked to learn the new task than when they are required to recall it after 3 weeks.

Conducting a study to evaluate the relative effectiveness of discovery and expository methods of teaching chemistry to class three secondary school students, Nworgu (1985) used 100 55 drawn from two school (one-all male and the other – all female). This protest results show no significant difference in the basal abilities of the treatment groups. In conclusion, however, he suggested that the discovery method yield significantly better results than the expository method. According to him, there is a significant interaction between sex and teaching method; so his generation across all gender levels could be drawn on the relative effectiveness of the discovery and expository methods.

Reporting the results of his study titled "A comparative study of the effectiveness of three methods of teaching a secondary school physics course in a Nigeria Secondary School," Olarinoye (1982) concluded that there was no significant difference found between the mean gain scores earned on the academic achievement test by the

i. control group taught with guided inquiry method and

ii. experimental group taught with inquiry role approach method and the

iii. control group taught with the traditional method.

Reviewing past studies, Olarinoye reported that at certain instances, discovery method does well at the level of immediate learning and later retention in science, and at another, the expository and laboratory methods were significantly more effective than the discovery methods were significantly more effective than the discovery method in overall achievement, verbalization of certain concepts, recognition of concepts and solution to numerical problems.

The uncertainty in the outcome of science teaching confirms the belief that the differences between teaching styles lies in the role ascribed to each of them and because of the emphasis normally given to some elements like classroom discussion and laboratory experiment) or methodology.

Behavioural Objectives in the Science Approach

The importance of behavioural objectives to instructional operatives especially in curriculum field cannot be over-emphasized. And science teaching is one of the areas that rely very much on the clarity of stated objectives.

Behavioural objective is a clear statement of the students' behavior that will be accepted as an evidence of his having achieved what he and the teacher set and to accomplish (MPKA, 1984). Tyler (1949) said that a statement of objective dear enough to be used in guiding the selection of learning experiences and in planning instruction will indicate both the kind of behavior to be developed in the students and the area of content or of life in which the behavior is to be applied. Among the advantages of behavior objectives are;

1. They help the teacher become more precise in his teaching.
2. They clarify exactly what is expected.

3. The teacher plans more carefully because he knows what performance his students should display after finishing a lesson, unit or course of study;
4. The teacher knows what materials are needed and is able to give more specific help to students in directing them to outside sources of information (Sund and Frawhrideje, 1973).

Considering the intellectual development of the child, whom in this case is the learner, Bruner (1965, P-33) hypothesis that: "Any subject can be taught effectively in some intellectually honest form to any child at any stage of development… the task of teaching one of representing the structure of the subject in terms of the child's way of viewing things."

According this argument, Abdullahi (1981, pg.107) maintained that the starting point in the teaching of science is the specification of objectives to be achieved because objectives thus become the criteria by which instructional materials are selected, content is organized by which instructional materials are selected, content is organized based on the background of the student, and evaluation of the content to which the objectives have been attained is prepared.

Similarly, Badmus (1976) summarized that All, or almost all students can learn well.

1. If instruction is systematically approached,
2. If students are provided with adequate help when and where they have learning difficulties,
3. If they are given sufficient time to achieve mastery and
4. If there is some clear criterion on what constitutes mastery.

Like Shaibu, Balogun (1982) reported that many teachers, with the very up to date science programmes continue to lecture and that they ignore programme and textbooks that encourages the development of process skills in students.

It is now believed that the modern education goes on “teaching by objectives” in which the lesson is a planned that the desire outcomes can be gauged in terms of overt, visible and quantifiable changes in pupil behavior. (Taiwa, 1984). In addition to having action verbs, behavioral objective preparation should take parameters like time factor, operational conditions and level of performance into consideration.

Science Concept in Learning

Science concept learning contributes in establishing curriculum content by determining students' understanding of concepts and students ability to describe and explain natural phenomenon.

Pella (1975) believes that concepts are either empirical or theoretical. Empirical concepts can be observed directly through the senses or measured by relatively simple techniques while theoretical concepts are not directly observable. For example, food, flowering plants and chemical compounded are directly observable, while genes, atoms and elections are not directly observable. Both empirical and theoretical concepts may be classified according to three levels. Namely – descriptive, comparative and quantitative. These three levels of concepts may be classified in terms of complexity with description being at the lowest level and quantitative at the highest level.

In the review of some studies, Murphy reported that before grade 5, there was no difference in the Mathematics achievement scores of boys and girls, nor was there real difference in their attitude towards Mathematics. But that as from that stage on, the boys moved steadily ahead of the girls both in terms of their attitude towards the subject and their achievement in it. And that there lies the problem of determining causation, but that it was most likely that sex rate stereotyping was responsible for the difference or attitude which in turn brought about the difference in achievement. He also reported that a cross cultural study has shown that sex differences varied considerably between different cultures and that the main cause of them is most likely to be found within the influence of the individual cultures. Similarly, Taylor (1976) reported that sex is an influential factor in the discovery method.

White and Tisher (1983) reported that research has been handicapped by absence of a mature theory encompassing the nature of attitude and their relation to other constructs, and that the external boundaries of attitude with personality attributes with abilities are blurred, and as are the internal one between interests, feelings, values and appreciations.

He went further to say that attitude can be learnt in a variety of ways. Nash (1976) described attitude as "personal meanings which an individual places upon his action… characteristics mode of action" while Whiltch and Schulter (1973) described attitude as perceived by Gagne, and that perception (the foundation of learning) is the ways in which man senses or immediately aware of his environment" and that for perception to bring about a valid understanding by a learner, certain conditions are necessary. These include:

The better an object, person, event or relationship is perceived, the better it can be understood and remembered.

2. Correct initial perception facilitates learning; imperceptions impedes it.

Summary

In relation to the concept of discovery as an approach to science teaching and the didactic method, there are claims of supremacy of one method over the other. It then shows that the attainment of instructional objectives depends upon how a specific instructional strategy is applied moreover, if the claims for supremacy of one method over the other are suspended and the areas that generate function are looked into by the parties concerned, an intellectual climate may be established.

Studies related to students performance and retention has show that different teachers give different emphasis for different instructional approaches. The end result of course, depends on how an instructional method is applied. For example, the results of the influence of gender differ from one research to another.

A good objective, Onyike (1985) believes, has 3 major components namely.

a. Behavior which identifies what the learner will be doing as evidence that he had achieved the objective.
b. Conditions which define the desired behavior further by describing the important conditions under which the behavior will be expected to occur and;
c. Standards which specify the criteria of acceptable performance by describing how well the learner must perform to be considered acceptable.

Unfortunately, a suitable formula for matching learning activities to objectives is still on illusion. This explains the reason why results of studies that involves the relationship between teacher's methodology and objectives in Science teaching has been uncertain. What may work for one teacher or with one group of students can be unsatisfactory in another situation. All the teacher needs to do is to know the strengths and weaknesses of the alternate methods.

An evaluation of a teacher's modes of instruction, transaction and interaction in the classroom has shown that, apart from the socio-economic background and attitudes of the learner, his role in relation to learning cannot be over-emphasized.

For example, among the teacher's roles are; the teacher as a manager, as a planner, as introduce, as rewarder, as value investigator, as questioner and sustainer of inquiry. Research results abound in the area of curriculum studies which has shown that a lot has to be done in order to sustain the above functions.

CHAPTER THREE

RESEARCH METHODOLOGY

This chapter presents the methods and procedure that was employed in this research work. It is presented under the following sub-headings;

1. Research design
2. Population of the study
3. Sample and sampling techniques
4. Research instrument
5. Validity and reliability
6. Administration of the instrument
7. Method of data analysis

Research design

This study involved the use of Campbell and Stanley's (1966) pre-test/ post-test control and quasi experimental group design.

The main independent variable of interest in the study was the treatment (guided discovery versus didactic methods of teaching Basic

Science). The dependent variable was retention capacity of Basic Science students. However, one other variable that could influence retention capacity of Basic Science students was gender of learners. Consequently, the Basic Science Achievement test A was administered as pre-test on the sample a few days before commencement of the actual treatment.

Population of the study

The population of the study consists of all Junior Secondary Schools in Egor Local Government area of Edo state.

Sample and Sampling Technique

Out of the total population, one school was selected for this experimental study. This was achieved by using a simple random sampling technique in which the balloting system was used to select the sample by writing ‘Yes’ or ‘No’ on a piece of paper carefully folded. Any school picked ‘Yes’ would be used for the study. This gave all the schools equal opportunity of being selected. In each of the two schools, two classes were selected (one used as the experimental and the other as the control group). A total of 85 Junior Secondary School III (JSS III) students from two intact classes of 45 and 40 respectively, constituted the sample of students involved in the study.

Research instrument

The measuring instruments used in this study were basic science achievement tests, A and B and a retention test. In addition, two teaching plans, A and B were also developed and used in the study.

The Basic Science Achievement A was used as a pre-test to assess the equivalence of the two groups (experimental and control) with reference to their achievement prior to the commencement of the treatment. The Basic Science Achievement Test B was a post-test instrument used in measuring the students' achievement after the treatment and the retention test was designed to retention capacity.

Teaching plan A was a series of lesson notes and lesson plan designed to guide the researcher in the treatment given to the experimental group. In content, it covered the unit area of digestion, Book III of the Basic Science Curriculum for JSS. Teaching plan B was a series of lesson notes and lesson plan designed to guide the researcher to guide the researcher to ensure that the prescribed method was indeed followed while teaching the control group.

Validity and Reliability of Instrument

In order to ensure content validity in terms of coverage, the two Basic Science Achievement Tests were constructed using tables of specification. The pre-test (Basic Science Achievement Test A) covered areas which were considered proper representatives of the content area, digestion. Five (5) of such areas were identified as shown in the table below. The post and retention tests contained the same items as in pre-test but modification was made by rearranging the test items and changing the types.

Table 1:Table of specification of items on Basic Science Achievement Test: Level of cognitive thinking

Content	%	Knowledge (30%)	Comprehension (20%)	Application (30%)	Interpretation (20%)	Total (100%)
1. Concept of metabolism, catabolism and anabolism	20%	3	2	3	2	10
2. Digestion of carbohydrate	20%	3	2	3	2	10
3. Digestion of proteins	20%	3	2	3	2	10
4. Digestion of fats and oils	20%	3	2	3	2	10
5. Absorption of food.	20%	3	2	3	2	10
Total	100%	15	10	15	10	50

This is based on Bloom's classified educational objectives of an intellectual nature (the cognitive domain).

The two instruments were later given to 2 specialists in science education who scrutinized them for ambiguity in language and appropriateness of items over the levels of cognitive domain. Moreover, the teaching schedules were given to the researcher's supervisor and other science education specialists to ensure that

1. The post-test was really designed to test the contents of instruction.
2. The teaching-learning methods prescribed were followed during implementation.

The reliability of the two measuring instruments- the Basic Science Achievement Tests were estimated using split-half reliability and Spearman Brown formula.

The pre-test had a reliability estimate of 0.60. This apparently low estimate of reliability is a general characteristic of criterion-referenced tests. It should be noted that the 2 BAT are criterion-referenced in nature and their validity was ensured through the use of specification; and it is even of greater importance than reliability (Badmus, 1977).

Administration of the instrument

Two arms each of JSS III had 45 and 40 students each and were assigned into each as experimental and control group.

The experimental group was taught by the researcher using the guided discovery method as described in lesson plan A. The control group was also taught by the researcher using the didactic method as described in lesson plan B. Each of the two groups were exposed to two lessons lasting 35 minutes each. The two groups were finally given a post-test as contained in the achievement test B. Four weeks later, the retention test was administered though no previous announcement was made about this

.

Method of data analysis

The statistical tool employed for data analysis is t-test for independent groups and Analysis of Co-variance (ANCOVA).

T-test - The study involved two independent variables, guided discovery and didactic instructional methods which call for nominal measures. The dependent variable (scores on achievement tests) calls for interval measures. Since a comparison had to be made of the means of the two groups (guided discovery and didactic method), the T-test of significance was used. To analyze hypothesis 1&2, therefore, the means and standard deviation of each group of subjects were obtained and the two-tailed test of significance of difference between two means was used. Further attempt was made to compare the mean gains for each group of subjects.

Coefficient of variance – Hypothesis 3 & 4 was analyzed using the coefficient of variance. First, the range for each of the groups was obtained. The variance and standard deviation were also obtained. To ascertain the variability, the coefficient of variance was computed by relating each standard deviation to the group mean.

CHAPTER FOUR

PRESENTATION AND DATA ANALYSIS

This chapter contains a summary of the data collected during the course of this study including the analysis and interpretation as they are related to the corresponding research questions. It is supported with the necessary statistical information, figures and tables. It is organized into the following sub-headings:

Equivalence of the experimental and control groups on a pretest in Basic Science Achievement pretest.

To ascertain the entry behavior of students in both classes, a pretest was administered to the groups. The findings are summarized in the table below:

Table II: Pretest scores of experimental and control groups.

	N	MEAN	SD	T	REMARK
PRETESTEXPT	45	12.5445	4.49049		Sign
PRETESTCONT	40	12.6364	3.18546	-.87	@ .932

The result in table II above shows that the mean scores of the experimental (i.e. students taught with guided discovery method) and control group (students taught with didactic method) were 12.5445 and 12.6364 respectively, indicating no significant difference between them. The performance of the two classes showed that no one had learnt the material that was to be taught.

The t-value obtained indicated that the respective classes were equivalent.

Research question one

Is there any significant difference in retention level between Basic Science students taught using guided discovery and didactic method?

In order to determine the effect of guided discovery on students' retention capacity, data were collected through the administration of a post test. The results are shown in the table below:

Table III: Post test scores of experimental and control groups.

GROUP	N	MEAN	SD	T	REMARK
POSTTESTEXPT	45	22.7727	6.40633	3.312	Sign @ .003
POSTTESTCONT	40	16.8182	5.44790		

Table III above shows that after treatment was given, there was significant increase in the mean scores of both experimental and control groups. It should be noted that the experimental group increased from 12.5445 in the pretest to 22.7727 in the post test while the control group increased from 12.6364 in the pretest to 16.8182 in the post test. This indicated that there was greater increase after treatment in experimental group than in the control group. The implication of this is that retention capacity of the experimental group was greater than that of the control group.

Therefore, there is significant difference in retention capacity between basic science students taught with guided discovery method and those taught with didactic method.

Research question two

Is there any significant difference between the retention capacity of male and female students taught with guided discovery method?

Table IVa: Descriptive data showing post mean scores of male and female students in the experimental and control groups.

GENDER		POSTTESTEXPT	POSTTESTCONT
MALE	Mean	23.0000	16.8182
	N	25	22
	Std. Deviation	6.36396	5.44790
FEMALE	Mean	18.8500	17.8333
	N	20	18
	Std. Deviation	4.22119	4.68100
Total	Mean	21.1556	17.2750
	N	45	40
	Std. Deviation	5.84246	5.07880

Table IV a above shows that there is significant difference in the mean scores of male and female students in the experimental group (23.0000 and 18.8500, respectively) in the post test. Performance of males is greater than females when compared to their control groups.

TABLE IVb**:** ANOVA Table of post test mean scores of experimental and control groups by gender.

	Sum of squares	Sum of squares	df	Mean square	F	Sign.
POST TEST EXPT	Between groups (combined)	191.361	1	191.396	6.279	0.16
	Within groups	131.550	43	30.478		
	Total	1501.911	44			
POST TEST CONT	Between groups (combined)	10.202	1	10.202	.389	.536
	Within groups	995.773	78	26.205		
	Total	1005.975	39			

Table IV b above shows that the f-value of the post test is significantly larger than that of the control group. This shows that there is significant difference in mean scores of male and female students taught using guided discovery

Table IV c: Descriptive data showing retention scores of male and female students

GENDER		RETENTIONEXPT	RETENTIONCONT
MALE	Mean	21.5200	16.3182
	N	25	22
	Std. Deviation	6.23912	4.79470
FEMALE	Mean	17.9500	18.0000
	N	20	18
	Std. Deviation	3.91320	4.43250
Total	Mean	19.9333	17.0750
	N	45	40
	Std. Deviation	5.57348	4.65413

The table above agrees with the results of that of table IV a. Mean retention score of male students is 21.5200 which is greater than that of female students (17.9500). From the findings so far, it can be concluded that there is significant difference in retention capacity of males and females taught with guided discovery method both after post test and after retention test.

Research question three

Is there any significant difference between the mean scores of the experimental and control groups in the Basic Science retention test?

Table V a: Table showing mean scores on retention for experimental and control groups.

GROUP	MEAN	N	SD	T	REMARK
RETENTIONEXPT	21.7727	45	6.40633	3.452	Sign @ .002
RETENTIONCONT	14.3182	40	4.79470		

TABLE V b: ANOVA table showing significant difference in retention scores of experimental and control groups

		Sum of squares	df	Mean square	F	Sig.
RETENTION EXPT GENDER	Between groups (combined)	141.610	1	141.610	4.970	.031
		1225.190	43	28.493		
	Total	1336.800	44			
RETENTION CONT	Between groups	28.002	1	28.002	1.303	.261
	Within groups	816.773	38	21.494		
	Total	844.775	39			

The table above shows a significant difference in mean scores of both experimental and control groups after the administration of retention test. The experimental group had a mean score of 21.7727 while the control group had a mean score of 14.3182. The implication of this is that after 4 weeks had elapsed between the administration of the post test and the retention test, the experimental group had lesser loss of learned material as indicated by their decrease from post test score to retention score (22.772 to 21.7727). In contrast, the control group experienced greater loss of learned material after 4 weeks from post test score to retention test score (16.8182 to 14.3182). It is therefore concluded that there was a significant difference between the mean scores of experimental and control groups in basic science retention test.

Discussion of findings

In all, three main results were obtained as regards the consequences of the guided discovery and didactic instructional method.

Analysis of the scores in post-test shows a statistically significant difference between the performances of the two groups of students.

The experimental group had a higher performance as indicated by the post mean score (22.7727) than the control group (16.812). The findings are in agreement with the findings of earlier researchers, Ibanga (2005), James and Shuaibu (1997). These researchers concluded from their investigations that students taught using the guided discovery method perform better in cognitive tasks involving critical thinking than those in lecture (didactic) class. Egbule (2000) noted that the greater the students involvement, the greater the leaning and level of retention. Abdullahi (1982) pointed out that since students find out information for themselves through guided discovery, retention of knowledge is better facilitated. The findings from the results of the retention tests indicated that there was a statistically significant difference between the retention capacity of the experimental and control groups.

On the result of the effect of guided discovery method on the retention level of male and female students, the post mean score of the male students was 23.000 which is higher than that of the female students (18.8500). This shows that male students taught with guided discovery method performed better than their female counterparts taught with the same method. This is in agreement with the findings of Okogie (2001) who reported that retention rates are lower for girls than boys. Ugwungwu and Ezike (2000) noted that many factors have been known to affect academic performance of students in science and basic science in particular. Among these is the difference between boys and girls (gender).

Taking a close look at the retention scores of the guided discovery (experimental) and didactic (control) group, it is observed that their mean scores dropped from 22.7727 to 21.7727 for the experimental group and 16.6128 to 14.3182 for the control group indicating greater loss of learned material for the control group than the experimental group. This implies that the guided discovery method is effective in enhancing the retention capacity of basic science students.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The purpose of this study was to investigate the effectiveness of the guided discovery instructional method in enhancing the retention capacity of basic science students in Egor Local Government area of Edo State.

It became necessary when it was realized that the average Nigerian child has problems with retention which ultimately affects his academic performance. Some of the factors contributing to this include teaching strategies, intelligence, learning environment, motivation, aptitude, amongst others.

Teaching is a polymorphous activity which involves other processes like continuous assessment, questioning style, method of lesson presentation and so on. In order to contribute to knowledge which may alleviate some of the problems which normally contribute to student's poor performance in basic science, the effects of two teaching methods (guided discovery and didactic) were analyzed.

In all, a sample of 85 junior secondary school student were used for the study. It was further divided into 2 groups- the experimental (guided discovery) and control (didactic) class. Three measuring instruments (the Basic Science Achievement Test-A –a pretest instrument used in determining the equivalence of the two groups, the Basic Science Achievement test-B –a post test instrument, and the retention test for measuring retention level after 4 weeks) were used. They were constructed using tables of specification and were later validated by science education specialists. Using Spearman Brown formula, their test-retest reliability coefficient was estimated to be 0.60 and 0.55 respectively.

Two teaching plans (one for the experimental group, taught with guided discovery method and the other, for the control group, using the didactic method) were developed by the investigator. These were reviewed and approved by specialists in science education.

Data analysis involved computation of means and standard deviation, t-test and the use of Analysis of Covariance (ANCOVA).

Conclusion

Altogether, there were three main hypotheses used for the study and a summary of statistical findings are shown below:

1. There was a significant difference in retention capacity between basic science students taught with guided discovery and didactic method. The guided discovery method was found to be superior to the didactic method.

2. There was a significant difference in retention capacity of male and female students taught with guided discovery method. Gender of students significantly influenced the performance of students (both sexes).

3. There was a significant difference between the men scores of the experimental and control groups in the basic science retention test.

Based on the findings of the study, it was concluded that the guided discovery instructional method enhances the retention capacity of basic science students, thus, promoting meaningful learning and high cognitive achievement in basic science. Students taught with guided discovery method, apart from achieving high scores, also retained more content material than those taught with the didactic method. Secondly, gender difference has a lot of influence on students' retention capacity.

Recommendations

Based on the results of this study, it is recommended that

1. In-service courses, seminars and workshops should be organized on the guided discovery instructional method and its operating procedure in all the educational zones and attendance made compulsory for all science teachers.

2. The teacher-education programme should include teacher-competence based courses for the successful implementation of the National Policy on Education.

3. Since the guided discovery method has been found to be effective, there is need to emphasize its use in secondary schools, especially in teaching basic science and other science courses.

4. Policy makers in the Ministry of Education and participants should lend full support to make this method a reality,.

5. Teachers already in the field should be subjected to regular inspection by the older, more experienced, and specialists in the area of instructional approaches. This calls for training of more of such personnel. Instructional strategies should involve class interaction among students (including males vs. females), students and teachers and with materials. This calls for the provision of instructional aids in schools.

6. Recruitment of more female science teachers to serve as role models.

7. Guided discovery is cost-intensive. Therefore, government and philanthropists should make adequate funds for smooth implementation.

Suggestion for further research

1. It is suggested that similar research studies be carried out between categories of students (higher, average and low achievers) to know the category that performs better than others. Average performances may also be determined.

2. Further research should also be conducted in the area of level of concept attainment in order to establish the relationship between the level of concepts (descriptive, comparative and qualitative levels) and the guided discovery method.

3. In addition, a similar investigation should be carried out where the number of schools should be increased.

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APPENDIX

BASIC SCIENCE ACHIEVEMENT TEST

Class: JSS 3

Time Allowed: 40 minutes

Instruction: Answer all questions

1. Pepsin converts ------- to --------- (a) protein to peptone (b) lactase to lactose (c) fructose to glucose (d) protein to polypeptides.
2. Absorption of food occurs in the ------- (a) stomach (b) blood (c) villi (d) duodenum.
3. Ptyalin is found in the --------- (a) stomach (b) small intestine (c) mouth (d) villi.
4. The tongue rolls the chewed food into (a) bollus (b) bolus (c) lumps (d) none of the above.
5. ---------- muscles are present in the stomach (a) cardiac (b) smooth (c) sphincter (d) stomach.
6. Gastric juice contains all but one of the following (a) rennin (b) HCL (c) pepsin (d) trypsin

7. Digestion is a/an ------ process (a) catabolic (b) anabolic (c) metabolic (d) none of the above.
8. Gastric juice is secreted from the ------- (a) liver (b) pancreas (c) stomach walls (d) gastric wall.
9. Enzymes are --------- (a) gastric juices (b) biological catalysts (c) hormones (d) none of the above.
10. Digestion of carbohydrates starts in the ------- (a) stomach (b) mouth (c) duodenum (d) oesophagus
11. The mechanical and chemical breakdown of food into absorbable portions is known as (a) chewing (b) absorption (c) digestion (d) feeding.
12. The opposite of catabolism is -------- (a) metabolism (b) digestion (c) breaking down (d) anabolism.
13. The process of digestion occurs in --------- parts of the body (a) 4 (b) 7 (c) 6 (d) 5.
14. Ptyalin converts -------- to ------- (a) casein to caseinogens (b) starch to maltase (c) starch to maltose (d) protein to amino acids.
15. Peristalsis occurs in the -------- (a) stomach (b) mouth (c) large intestine (d) oesophagus.

16. Digestion process occurs in the ff parts except (a) mouth (b) liver (c) duodenum (d) oesophagus.
17. Pancreatic juice is --------- in nature (a) alkaline (b) acidic (c) natural (d) proteinous.
18. Protein digestion starts in the (a) stomach (b) mouth (c) small intestine (d) large intestine.
19. Rennin converts ------ to ------- (a) caseinogens to casein (b) protein to polypeptides (c) starch to galactose (d) polypeptides to peptones.
20. Pancreatic juice contains ------- enzymes (a) 3 (b) 4 (c) 5 (d) 2.
21. The first part of the small intestine is -------- (a) ileum (b) duodenum (c) jejenum (d) pancreas.
22. Gastric juices are -------- in number (a) 2 (b) 3 (c) 4 (d) 5.
23. Bile is stored in the --------- (a) pancreas (b) bile canal (c) gall bladder (d) duodenum.
24. The sphincter muscles -------- (a) churn food (b) relax to admit food (c) cause vomiting (d) none of the above.
25. Bile is -------- in colour (a) greenish (b) black (c) yellowish (d) colorless.

26. The function of bile is to (a) digest oil (b) emulsify fats (c) digest protein (d) none of the above.

27. Absorption of food takes place in the -------- (a) villi (b) stomach (c) ileum (d) large intestine.

28. The end product of oil is -------- (a) glycogen (b) glycerol (c) fatty acids (d) maltase.

29. The jejenum and ileum are found in the -------- (a) small intestine (b) large intestine (c) stomach (d) gastric juice.

30. Water is absorbed in the -------- (a) small intestine (b) mouth (c) blood (d) large intestine.

31. ---------- is not an intestinal juice (a) maltase (b) maltose (c) lactase (d) sucrose.

32. Intestinal juice is -------- in nature (a) neutral (b) acidic (c) alkaline (d) none of the above.

33. Undigested food goes to the -------- (a) large intestine (b) blood (c) small intestine (d) villi.

34. --------- and ------- are intestinal juices (a) maltase and maltose (b) lactase and amylase (c) lipase and erepsin (d) sucrose and erepsin.

35. Lipase converts ------- to --------- (a) starch to maltose (b) fats to fatty acids (c) oils to glycerol (d) B & C.

36. The end product of fat is -------- (a) fatty acid (b) glycerol (c) galactose (d) glucose.

37. Emulsifying is to fats as deamination is to --------- (a) starch (b) protein (c) amino acids (d) glucose.

38. Faeces are ------- (a) unwanted food (b) undigested food (c) excess food (d) bad food.

39. The end product of protein is ------- (a) peptone (b) pepsin (c) amino acid (d) polypeptides.

40. -------- is not a pancreatic juice (a) erepsin (b) trypsin (c) amylopsin (d) lipase.

41. -------- converts starch to maltose (a) trypsin (b) amylopsin (c) erepsin (d) lipase.

42. The end product of carbohydrate is -------- (a) maltose (b) glucose (c) starch (d) glycerol.

43. Excess fat is stored in (a) adipose tissue (b) liver (c) bile (d) villi

44. Vitamins and water are digested in the -------- (a) mouth (b) small intestine (c) large intestine (d) none of the above.

45. Glycogen can be stored in -------- (a) muscles (b) brain (c) marrow (d) small intestine.

46. Excess amino acids are stored in the (a) liver (b) skin (c) fat tissues (d) none of the above.

47. ---------- are biochemical catalysts (a) enzymes (b) rennin (c) bile (d) lactose.

48. Excess vitamin and minerals are stored in the ------- (a) skin (b) fat tissues (c) liver (d) none of the above.

49. Churning occurs in the ------- (a) oesophagus (b) stomach (c) small intestine (d) large intestine.

50. All biological process are either anabolic or catabolic (a) yes (b) no.