UNIVERSITY OF EDUCATION, WINNEBA

IMPACT OF ETHNOSCIENCE–ENRICHED INSTRUCTION ON ATTITUDE, RETENTION AND ACADEMIC MPERFORMANCE IN JUNIOR HIGH SCHOOL INTEGRATED SCIENCE AT SEFWI WIAWSO MUNCIPALITY

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DECLARATION

Student's Declaration

I, **Simon Anane**, declare that this thesis, with the exception of quotations and references contained in published works which have all been identified and acknowledged, the work is entirely my own work, and has not been submitted, either in part or whole for another degree elsewhere.

Student‘s Signature ……………………………………

Date……………………….…………………...………

Supervisor's Declaration

I hereby declare that the preparation and presentation of the project work was supervised in accordance with the guidelines on supervision of project work laid down by the University of Education, Winneba.

Supervisor‘s Name: Dr. Mrs. Felicity Bentsi – Enchill

Supervisor‘s Signature ………………………………….

Date……………………………...………….……….……

DEDICATION

This work is dedicated to Almighty God for His goodness, kindness and mercy to me all the time and to my mother and guardian, Manu Margaret for her support and encouragement in diverse ways, Stephen Anane and Patricia Sedoh for their encouragement and support throughout this journey.

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ABSTRACT

This study inquired into the impact of ethnoscience-enriched-instruction on attitude, retention and performance in integrated science among rural and urban students in the Sefwi Wiawso municipality in the Western North Region, Ghana. The research study adopted the quasi-experimental research design using the pre-test and post-test design. A randomly selected sample of 131 students from 4 schools. The schools were randomly assigned into experimental and control groups. The experimental groups were taught concepts using ethnoscience-enriched-instructions while the control groups were taught using traditional (lecture method). The groups were post-tested to determine their academic performances and attitudes after the treatment. They were further tested (post post-test) to determine the retention of learnt concepts. Data were collected using the Integrated Science Performance Test (ISPT), a 30 items multiple choice test with a reliability coefficient of 0.66; and the students' attitude to integrated science questionnaire (SAISQ) developed on a five point Likert's scale with a reliability coefficient of 0.75. The collected data were analysed to answer the research questions and test the null hypotheses. The research questions were answered using descriptive statistics. Hypotheses were tested using P-value of 0.05 and the following major findings were made: Students exposed to ethnoscience enriched teaching approach i.e. (Experimental group) achieved significantly higher than their counterparts taught using traditional method. Students exposed to ethnoscience enriched teaching approach retained the learnt concepts significantly better than their counterparts exposed to traditional method; There was no significant difference between the academic performance of urban and rural Junior High Schools; perception of students on Integrated Science after the introduction of the ethnoscience learning approach was positive. On the basis of these findings, some recommendations were made, one of which is that teachers of Integrated Science should use ethnoscience instructional strategy in their teaching as it enhances achievement and retention among JHS2 students.

CHAPTER ONE

INTRODUCTION

1.0 Overview

In this chapter, the researcher presented and discussed the background of the study, statement of the problem, purpose of the study, objectives of the study, research questions, significance of the study, delimitation, limitations and finally the organization of the study.

1.1 Background to the Study

Ethnoscience has been defined as cultural practices of a given people that have direct bearing to science or can be scientifically defined. It includes their practices of looking after themselves and their bodies, their botanical knowledge, and their forms of classifications (Abonyi, 2002). Ethnoscience is a term and study that came into anthropological theory in the 1960s. Often referred to as "indigenous knowledge," it introduces a perspective based on native perceptions. Ethnoscience looks at the intricacies of the connection between culture and its surrounding environment (Abonyi, 2002).

Science, as positioned today, is the basis for sustainable growth and development of a nation. The strength of a nation and the respect she commands from other nations are functions of her level of scientific and technological development. The increasing complexity of the world today imposes new and changing workforce requirements. This means that new workers will need ever more sophisticated skills in science, mathematics, engineering and technology which, in effect, require improved approaches to the teaching and learning of science. This explains why efforts are geared towards developing approaches that ensure the development of learners who would warm up to current workplace challenges. Consequently, Miles (2015) explains that academic success by science students requires that teachers implement a range of instructional strategies. This assertion informed the use of a number of innovative methods and strategies in the teaching and learning of science. For these methods and strategies to be effective, Bransford, Brown, Cocking, Donovan and Pellegrino (2000) highlight the importance of:

a. using appropriate just-in-time learning stimuli;
b. engaging students‘ preconceptions prior to teaching them new concepts;
c. providing deep foundational knowledge;
d. helping students make appropriate connections within the context of a conceptual framework;
e. organizing knowledge in ways that facilitate information retrieval and application;
f. allowing students more opportunities to define learning goals and monitor the progress in achieving them.

Though these groundbreaking methods and approaches have been proved to have worked somewhere else, they do not seem to have been effective among science learners in traditional environments where differences exist between learners‘ everyday life and the world of science. A number of reasons have been presented for this. Ogonnaya (2011), while analysing the situation, it was stated that the neglect of the diverse cultural activities and beliefs of the students and the failure of teachers to consider varied cultural resources of the students in teaching Integrated Science (and other sciences) remains one of the major reasons for the estrangement of the students from sciences. Hiwatig (2008) narrows the reason for poor achievement in science to lack of regard for the cultural belief of learners which greatly influence the attitude. He, therefore, acclaims the use of ethno-scientific teaching approach for classroom instruction in science. It is therefore important that an approach that is practical and relates science concepts to the day-to-day life of the learners be developed. To Cobern (1991), science as currently taught is a reflection of western history and foundational beliefs which makes it strange to learners in traditional communities in other parts of the world. These views are putting a question mark on the status of western science. This is perhaps why Absalom (2011) maintains that learners in the local non-western setting belief that science that is taught in schools often seems _not their own' meaning that the concepts look strange in the traditional environment. Abonyi (1999) also notes that current instructional approaches in science education which did not take into consideration prior cultural beliefs seem to have contributed to poor concept formation and students' interest in science.

Number of conferences have also made failed attempts at integrating indigenous elements into science curriculum. These include conferences in Addis Ababa in 1961, Tanunarive in 1962. There is therefore the need for a different approach to solving this identified problem. For such approach to be effective, it must meet some criteria as identified by George (2001) Thus,

- access different ways of thinking about scientific concepts;
- bridge the gap between the traditional and the conventional.

This informs the need for an instructional method that is culturally responsive and students centred. Ethnoscience instruction has been identified as meeting these criteria (Abonyi, 1999). In justifying this, Fasasi (2017) defines ethnoscience instruction to mean the instructional approach that systematically accesses and assesses the prior cultural beliefs and ideas of learners that are related to the science concept being taught to ensure a better understanding of the concept. School location has been a contentious issue in the determination of cognitive achievement in science education. Ndukwu (2002) maintains that schools located in urban areas are better positioned to attract more quality students and teachers who exhibit the readiness to take academic business seriously which will invariably impact on the students. Onah (2011) supports this empirically by finding out that schools in the urban areas achieved more than schools in the rural areas in science subjects. On the contrary, Bosede (2010) shows that school location has no effect on students' academic achievement in science. What is therefore the relationship between science students in urban and rural schools when ethnoscience instruction is used?

The ability of learners to remember what they were taught after some time is an important component of learning. It is referred to as retention. Retention refers to the ability to remember things (Hornby, 2006). Bichi (2002), defined retention as the ability to retain and consequently remember things experienced or learned by an individual at a later time. Teaching strategies that emphasize rote learning and that are expository in nature has been criticized for not enhancing retention ability in students. Akinbobola and Folasade (2009) supported the fact that when teaching is characterized by rote learning, the facts are not retained, nor would they have effect in changing learners' behaviour. This is because; learning processes are related to the psychological stage of a learner. Learners at the concrete operation stage, requires hands-on experiences for meaningful learning. These concrete experiences could be in form of practical and other practices that occur with or around them. In this, the lecture method is very deficient (Akinbobola and Folasade, 2009). Hence the need to develop learner friendly approaches that could make a learner see himself as a potential scientist, explorer and finder of new knowledge through enquiry into his home environment, cultural practices and traditional beliefs that have relative bearing to science and science related practices. This is referred to as ethnoscience.

The interaction between students' attitude to science and their academic performance is an important area of interest to this research. Attitude refers to a person's disposition to respond to, in a consistent favourable or unfavourable manner toward a given object (Ibraheem, 2008). Adesina and Akinbobola (2005), viewed attitude as the evaluative dimension of concepts acquired through learning that can be changed through persuasion using a variety of techniques. It can also be described as a state of readiness, a tendency on the part of the individual to act in a certain way.

Attitude is an important factor in students' learning and performance as Adesoji (2008), reported that students' positive attitude to science correlates highly with their academic performance.

A number of factors that relate to students' attitude to science have been identified. Adesoji (2008), reported that a significant relationship exists between attitude and method of instruction and also between attitude and performance and it is possible to predict performance from attitude scores. Obumanu & Adaramola (2011), identified teaching method as a factor that influence students' attitude to science. They also stressed that student's negative attitude towards science discipline is because teachers do not apply the right activities during instructions. Dana (2006) observed that a person's attitude is learned not inherited and that such attitudes can be influenced through effective instructional strategies. Such instructional strategy must be able to influence learners by appropriately engaging all their learning domains. However, Westen (1996) observed that what we think about our situation affects our behaviour. Thus, the attitude of our students towards science could be a function of their perception of its difficulty (Adesoji, 2008) and/or the African perception of their inability to develop new knowledge from their ―inferior" cultures. This situation needs to be checked as no culture is a-scientific and many principles of native knowledge were scientific (Westen, 1996, Obidi, 2005). Thus, Africans must explore their cultures and come up with empirical evidences or scientific explanations of some of their practices. This study therefore, assesses the Impact of Ethnoscience-Enriched-Instruction on students' Attitude, Retention and hence Academic Performance.

An important factor that is of relevance to this study as it affects students' academic performance is students' location. Location refers to the place where something exists (Hornby, 2006). Location therefore is the environment in which a student grows up and/or schools in (Uju, 2006). Conventionally, societies are classified into urban and rural settlements based on some parameters like population and availability of basic infrastructure. These locations pose challenges as students that grew up from the urban area could be at advantage at accessing modern gadgets that could expand their learning horizons thereby improving their performances relative to those brought up in the rural areas.

Research reports of Habib (2003), Uju (2006) and Ferguson (2009) observed that academic performance varies with location. Brown and Swanson in Michigan (2013) observed that students' performance is greatly affected by the area in which they live. Reasons for the variations in performance include geographic location, resources, availability of technology, quality of teachers, cultural settings and inclination, open mindedness, socioeconomic status etc. Of great importance is the assertion that rural students are disadvantaged by their location, culture, and lack of access to similar facilities as their counterparts living in the city. Similarly, the feel that the rural schools may be somehow inferior could affect students‘ performance.

Researches in effects of location on students‘ academic performance is inconclusive. Some studies reveal that rural and urban students had comparable levels of performance in some tested learning areas (Young, 1998); while Uju (2006) reported that recent educational research has revealed rural-urban gaps in students‘ performance. Some studies reveal rural students outperforming their urban counterparts (Williams, 2007) and vice-versa. Most of these researches were based on the assessment of students‘ performances in the traditional classroom instructional process that is mainly lecture oriented (Uju, 2006) devoid of the influence of the interaction with learners‘ home environment and practices (United Nations Educational Scientific Cultural Organization (UNESCO, 2006). This study therefore explored the use of learners‘ local practices in form of ethnoscience-based teaching strategy and determined its impact on students‘ academic performance, retention and attitude to Integrated Science.

1.2 Statement of the Problem

Quality teaching and learning is needed to enhance the understanding and academic achievement of students in Integrated Science at the Junior High School level. However, there has been a low performance of students in Integrated Science at Junior High Schools in Sefwi Wiawso Municipality and Ghana as a whole which causes a threat to learning. (Chief examiner‘s Report (WAEC, 2018). As important as Integrated Science is, the persistent failures of the students in it has remained a major threat to its learning. (Uloko and Imoko, 2007).

Aworanti (1991), in his research on the teaching of Integrated Science revealed that teachers use different teaching methods in their instructional delivery such as lecture, cooperative teaching, Inquiry – based instruction etc. This, he concludes, has serious implications for cognitive performance in the subject. Similarly, Odetoyinbo (2004) stressed that the method of teaching Integrated Science is completely out of phase with background and local environments of learners. This is because most of the illustrations, equipment and even the language of communicating science are foreign. He posited that the method, being foreign in nature, has no bearing with the Ghanaian culture, and purely derived from euro-centric culture. The consequence of this over dependence on foreign approaches is that students are forced into rote-learning and low performance in science as could be seen today.

Attempts to find solution to this unremitting failure have made researchers in science education to consider a number of factors such as aptitude, goals and aspiration, motivation and instructional strategies. One of such factors which is re-examined in this study is the inappropriate method of teaching. This has necessitated the need to investigate the Impact of Ethnoscience – Eniched Instruction on Attitude, Retention and Performance in Integrated Science among Junior High schools in Rural and Urban areas in Sefwi Wiawso Muncipality.

1.3 Purpose of the Study

The purpose of the study is to investigate the impact of Ethnoscience – Enriched Instruction on Attitude, Retention and Performance in Integrated Science among Junior High Schools in Sefwi Wiawso Municipality.

1.4 Objectives of the Study

The objectives of the study are to:

1. Determine the impact of ethnoscience-enriched-instruction on academic performance of JHS 2 Integrated Science in Urban and Rural schools in sefwi Wiawso Municipality.

2. Determine the impact of ethnoscience-enriched-instruction on the retention of Integrated Science concepts among Rural and Urban students in Sefwi Wiawso Municipality.

3. Find out the perceptions of students in learning Integrated Science.

1.5 Research Questions

The under listed question was posed to guide the study:

1 What is the difference between the academic performance of urban and rural Junior High Schools Integrated Science performance " taught using ethnoscience-enriched instruction and those taught using lecture method?

2 What is the difference in the retention of Integrated Science concepts between urban and rural Junior High School students taught using ethnoscience-enriched instruction and those taught using lecture method?

3 What are the students' perceptions in the learning of Integrated Science?

1.6 Null Hypotheses

The following null hypotheses are formulated for testing at $p < 0.05$.

Ho_1

There is no significant difference between the academic performance of urban and rural Junior High School Integrated Science " taught using ethnoscience enriched-instruction and that taught using lecture method.

Ho2

There is no significant difference in the retention of Integrated Science concepts between urban and rural Junior High Schools students taught using ethnoscience-enriched instruction and that taught using lecture method.

1.7 Significance of the Study

1 The findings of this study will serve as a guide for curriculum planners to understand the impact of ethnoscience-enriched instruction and provide a basis as how they could be used in teaching.

2 The study will provide book writers and publishers the opportunity/evidence of using the culturally relevant practices as illustrations and exercises in their books.

3 The study will provide researchers with relevant and current literatures for similar researches as well as provide foundation for further research.

1.8 Delimitation of the Study

It could have been very appropriate and beneficial to include form one and form three students the school but this could not materialise due to the fact that form one students are new to the school system and not settled, so it would not be appropriate to use them for this study and form three students were also preparing for their final exams. So, form two students were chosen because they are settled and not taking final exams like the form three students. Moreover, other factors such as financial constraints, time and distance also affected the study.

1.9 Basic Assumptions

i. The students used for this study have had adequate introduction to science instruction via traditional teaching methods such as lecture methods but are not exposed to ethnoscience-enriched-instruction in Integrated Science Teaching;

ii. The selected topics and/or concepts are appropriate to the students‘ levels;

iii. The study subjects are familiar with the concepts to be taught in the study;

iv. The concepts selected can easily be linked to the environment by the study sample.

1.10 Organization of the Study

This study was organized into five chapters. Chapter one is the introductory part of the study. It comprised of background to the study, statement problem, objectives, research questions and significance of the study. Chapter two consisted of literature review on the Impact of Ethnoscience – Enriched instruction on Attitude, Retention and Academic performance in Junior High school Integrated Science at Sefwi Wiawso Muncipality. It reviewed and discussed the issues in the literature both in Ghana and elsewhere. The third chapter is the methodology section that was used for the research. It includes the study design of the population, sample procedure and data analysis. It discussed how data was collected and the instruments used for collecting the data. Chapter four comprise of results and discussions of the research. The fifth chapter presents the summaries of findings, conclusions and recommendations of the study.

1.11 Operational Definition of Terms

Rural Area: A settlement with a population of less than 50,000 inhabitants that are engaged in subsistent livelihood activities.

Urban Area: A settlement with a population of more than 250,000 inhabitants and engaged in secondary livelihood activities.

Ethnoscience: Cultural practices of a given people that have direct bearing to science or can be scientifically defined

Performance: Attainment or acquisition of knowledge and academic skills.

Retention: Ability to recall learnt concepts after a given period of time.

Attitude: Way of feeling, thinking about a phenomenon.

Pre – test: refers to the test administered to students before treatment to ensure parity

Post – test: is the test administered to students after treatment to determine their level of performance

Post – post-test: refers to the test administered to students' weeks after treatment to ascertain their retention level.

1.12 Abbreviations and Acronyms

ISPT: Integrated Science Performance Test

SAISQ: Students Attitude to Integrated Science Questionnaire

JHS: Junior High School

TLMs: Teaching and Learning Materials

CHAPTER TWO

LITERATURE REVIEW

2.0 Overview

In this chapter issues in the literature relating to Ethnoscience – enriched instruction and other instructional strategies are reviewed and discussed. Literature review discusses Teaching of Integrated Science, Contemporary Teaching Strategies in Integrated Science, Science and Culture, Ethnoscience and Science Teaching and Learning, Students‛ Location (Urban & Rural) and Academic Performance. The review also discusses Instructional Strategy and Students‛ Retention of Learnt Concepts, Students‛ Attitude and Performance in Integrated Science, Implications of the Literature Reviewed for Present Study.

2.1 Theoretical Framework

This study is premised on the theory of meaningful learning. (Ausubel, (1968). He argued that the conceptual understanding gained by a learner during instruction depends on both the incoming ideas/knowledge and the individual‛s innate ability to organize or restructure his/her pre-existing conceptual framework (Tobin, 1990). Glasserfield (1989) stressed that learners construct their own knowledge as a result of their interaction with certain natural phenomena. Such constructs form the bases upon which the new knowledge is anchored. This and similar understandings are based on Ausubel‛s theory of meaningful learning. In this theory, Ausubel stressed that prior knowledge plays a vital role in the students‛ learning. He observed that the human mind has a way of ―subsuming" information in a hierarchical or categorical manner in as much as the information or knowledge is linked to or incorporated with familiar pattern. Ausubel further stated that when relevant subsumes do not exist, to link new materials with the previous knowledge, then advance organizers or alternative set of link or anchorage can be introduced. The advance organizers are meant to provide a link between what the students know and what they need to know. They also provide some mind set for the students to learn new things.

The advance organizers occur against the experience of the learner that he/she obtains through his personal interaction with his environment. The nature of the environment in which the learner grows and lives in affects his world view and also learning. Linking learning to the learners' world view provides good learning opportunities to the learners. However, these learning environments are classified into Urban and Rural environments. Learners in the urban environment are exposed to modern facilities and gadgets that shape their world view thereby distracting them to several cultural practices. Conversely, learners in the rural areas are exposed to cultural practices like swimming, fishing, hunting, local blacksmithing, farming, etc. that exposes them to several practices that shapes their worldview (Hendrickson, 2010).

Although these practices could be obtained in the urban areas, they are not as frequent as they are in the rural areas. This makes urban learners to overlook their importance due to their perception of ―modernization". With the difference in the importance of the cultural practices among learners, it is important to investigate its effects on urban and rural learners" academic performance. Hence, the need for the present study.

Similarly, it is typical of African cultures to classify responsibilities by gender. Thus, some cultural practices like hunting are believed to be for male; while some (for example. sieving, winnowing, cooking, etc.) are believed to be for the female. This leads to gender dichotomy in the understanding and usage of the cultural practices. Since culture plays important roles in shaping the skills, interest and academic performance of male and female students (Westen, 1996), there is the need to employ such cultural practices in the teaching of scientific concepts to enable learners navigate the maze between scientific culture and their indigenous culture. Hence, this study assessed the impact of ethnoscience-enriched-instruction on the academic performance of students based on gender.

2.2 Cultural – Historical Activity Theory (CHAT)

Cultural historical activity theory, holds that any human activity can be described and analysed and that all activities have a structure, happen under certain conditions and can be assisted by particular tools, instruments or artifacts and are performed to meet a purpose.

The CHAT concept of activity connotes several things at once that the English notion of activity (as task) generally does not. In CHAT, the idea of activity centres on human collectives rather than individuals. It involves people operating jointly in a persistent system of relations with other people and institutions as well as with the natural world. Activity is not ―behaviour" in the sense of the focus of the study of Western psychology. Activity is a process-as-a-whole, rather than linear sequence of discrete actions. Therefore, an activity system is conceptualized as an indivisible, molar unit of analysis, not an additive one that could be disaggregated (Leont'ev, 1978). For example, analysing only what actors do with their tools does not constitute analysing an activity system.

2.3 Instructional Methods of Teaching Science (Integrated Science)

There are various methods of teaching. They are discussed in the following sections

2.3.1 Lecture method

This is the method of teaching that emphasizes ―talk and chalk" to the teaching of science subjects. More than 70% of scientific information and principles are delivered as lectures (Abdullahi, 2005). Science teachers embraced this method for easy coverage of the school syllabus. This method is sometimes referred to as the ―talk and chalk" method. It is characterised by the one – way flow of information. From the teacher who is always active, to the students will always be passive. In its true nature, the lecture approach is not effective for science teaching (Usman, 2000; Abdullahi, 2005). Lecture method is not effective for the following reasons:

i. It does not promote much meaningful learning of science as it appeals to hearing only.
ii. The differences in student's ability are not considered because it cannot satisfy the differences in individual such as slow learner and fast learner.
iii. The students easily become restless and disruptive since their attention span is very limited.
iv. It promotes rote learning and regurgitation of information (Abdullahi, 2005)

2.3.2 Project method

This method is used by teachers to individualise instruction; usually it is given to individuals or small group. Here, students are required to look for topics of special interest them and investigate solutions using projects. Project is one of the activities – based of science strategies which local resources can be effectively in teaching process. According to Jay (2003), Project method derived from the educational idea of one of the great educators, John Dewey, an American, Dewey argued that education should not prepare a child for future that is unknown, but rather it should fit him rightly into his society. One of the best ways to do this is to allow the child to take full part in the life of community and wider neighbourhood.

Later, the followers of Dewey further develop this idea into what we call in schools –the project method. Put it in another form, a school project: it is the cooperative study of real – life situation over situation b either a class or the whole school, usually under the expert guidance or a teacher (Bello, 1996), sometimes students obtain topics for the project work from the sources available. The teacher is expected to guide them where necessary. The project method could take a week, month, or even some years.

2.3.3 Discovery method

This approach in science teaching was postulated by Brunner (1961). The approach enables pupils to get first – hand experience in getting fact, concepts and principles and processes by using mental processes and manipulating scientific equipment and materials. Brunner believes that a child who is exposed to the heuristics of discoveries gets four (4) benefits these are:

i. There will be increase in intellectual attainment
ii. There is a shift from extrinsic to intrinsic motivation
iii. The learning of heuristics of discoveries is valuable to students‘ investigation processes
iv. Discovery learning aids memory of the child.

Finally, discovery method is one of the best methods of teaching that involves mental skills for learning by student to observing, measuring, classifying and so on (Usman, 2000; James, 2001)

2.3.4 Discussion Method

It is student – centred approach based on the philosophy that knowledge arising within the person and not from external sources. The students communicate over knowledge, while teacher moderates the discussion. Advantages are:

i. It can be used to introduce a lesson, which provides, which provides motivation for students' activities. Both the teacher and the students discuss procedure for the activities.

ii. It develops positive understanding between teacher/student and student/student, which motivates a desire to gain more knowledge.

iii. It provides the students with the sense of confidence through frequent exchange of idea between their teachers and students (Stanley, 2008).

2.3.5 Field trip

This is an important component of science teaching.it is trip or excursion taking outside the classroom for observation and obtain specific information. If well planned, it affords the students opportunity to become actively engaged in observing, classifying, studying and manipulating objects. From the foregoing discussion on the various methods of teaching science, it must be emphasized here that new approach of science teaching as advocated today is the student - centred approach (Stanley, 2008).

2.3.6 Demonstration method

This approach involves showing a particular procedure or skill to the students who after careful teaching, learning and interaction repeat and practice the same process shown them. The demonstration approach can be used when the available resources, equipment cannot go round for each individual in the class. The teacher or some groups of students usually carry it out. The approach is used to:

i. Motivate the students
ii. Teach certain techniques or skills, theory, practice etc.
iii. Introduce a lesson
iv. It saves time and materials
v. Shows the correct use of material and equipment

However, according to Stanley (2008), this approach could be harmful to students if carried out by them sorely without the guidance of a facilitator or teacher.

2.3.7 Laboratory method

This is an activity performed by an individual or a group of students for the purpose of making personal observations or processes, products or event.

It has been used in teaching science as:

i. A means of verifying principles, laws or theories
ii. Practicing one or more cognitive skills such as ability to observe, classify, measure, interpret data etc.
iii. To determine the relationship between causes and effects (Stanley, 2008).

2.3.8 Problem – solving method

Olekan and Jerome (2006) defined problem solving as a skill that requires finding a solution that is unique and novel to identified problems and it is also the ability to adopt relevant techniques from task only marginally related to the task at hand and to generate possible strategies to solve problems that are familiar. It demands strong background knowledge of concept, fact, structures, principles and computational skills that enable them to tackle problem in the classroom. Teachers and parents play significant roles in the growth and development of learners in the society to acquire skills for problem solving. This will also enable learners to acquire a cognitive style towards tackling of problems with little or no assistance from fellow students or teachers. Problem solving calls for an initial identification of problem, relation of problem to known idea or a problem earlier solved structure of the problem, carryout necessary computation, obtaining solutions, generalizing and analysing of solution procedure.

According to Inekwe (2002), to teach problem solving skill successfully, teachers must provide a more conducive learning atmosphere that will allow students to thinking, analysing, experimenting and be willing to entertain and answer questions to improve students' performance in the concept.

2.4 Conceptual Framework

Conceptual framework is the system of concepts, assumptions, expectations, beliefs, and theories that support and inform about study (Sitko, 2013). Learning by memorization in science classes is common because students have not been actively involved in the classroom activities. It is not surprising to see in science education a student with a grade but cannot link his or her classroom experience with the real –

world problem (Crouch et al., 2007). The reason is because they do not learn through ethnoscience learning instruction.

In other to have a learning where students can favourably apply classroom theory to real – world problems and improve students' academic performance in science education, there is the need for a shift of paradigm of pedagogy. The shift must be to an ethnoscience – oriented classroom practice. Miles (2015) supported this that science teachers should link methodologies that require a greater level of students' cultural practice. The thrust of this study, therefore, is changing of teaching paradigm to ethnoscience – oriented instruction because it is an interactive pedagogy. Teaching method like ethnoscience, group work and peer teaching make the students active in the class and aid students' high retention, but retention is low where students are passive. The reason is that they learned by memorizing just to pass the examination.

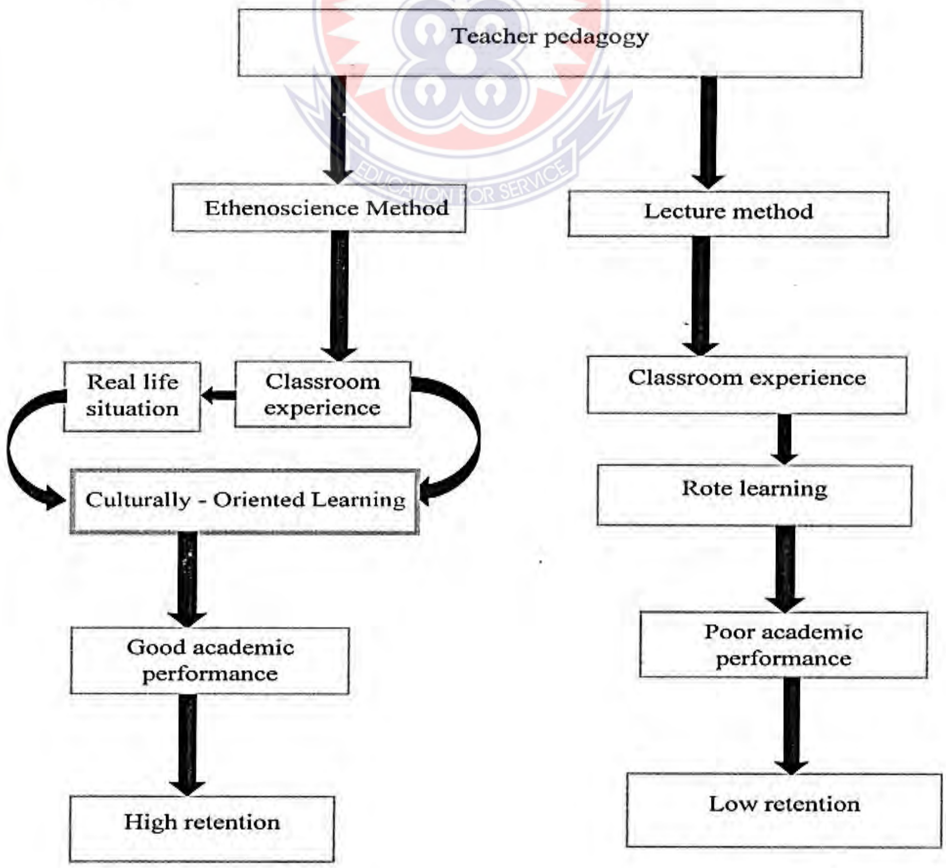

Figure 1: Conceptual framework of ethnoscience and Lecture Method of teaching and learning.

The conceptual framework indicates both active and passive students had classroom experience.(figure 1)

There is a link between active participation in the class and being able to solve real world problems. On the other hands, when the students are passive, it leads to rote learning. A student who can translate what he or she have learned into solving real – world problem will always have a better academic achievement Thus, higher retention.

However, students who always learned by memorizing will usually have poor performance and always have low retention with time.

2.5 Teaching of Integrated Science

Science has been defined as a human endeavour which man uses to explore the environment for his betterment. It is the basis of today‘s technological advancements.

Science plays a vital role in the lives of individuals and the development of a nation scientifically and technologically (Alebiosu & Ifamuyiwa, 2008). It is widely and generally acknowledged that the gateway to the survival of a nation scientifically and technologically is scientific literacy which can only be achieved through science education. For this, Fafunwa in Peni (2001) vividly captured the position of science in every society when he says we are living in a community where science and technology have become a fundamental part of the world‘s culture and any country that oversees this significant truism, does so at its own jeopardy.

Conventionally, the principles of science are usually employed in everyday activity among all communities (Obidi, 2005). These principles are informing of cultural practices like feeding, transportation, cooking, selection of bride, selection of viable seeds for the next planting season, catapulting, etc (Peni, 2007). However, in African society in general and Nigerian society in particular, the practices were employed to solve problems by individuals but the exploration of the scientific principle that underlie the practice were never explored. This created some intellectual „bankruptcy" among Africans. The need to change this situation prompted the inclusion of science into the school curriculum.

2.6 The Rationale of Integrated Science in Ghana

We are confronted daily with situations that require us to use scientific information to make informed choices and decisions at every turn. Modern life also requires general scientific literacy for every Ghanaian citizen. This is the only way by which the country can create a scientific culture toward achieving the country's strategic programme of scientific and technological literacy in the shortest possible time. Every citizen of the country needs training in science to be able to develop a scientific mind and a scientific culture. This is the only way by which people of the country could deal objectively with phenomena and other practical issues; prevent reliance on superstition for explaining the nature of things and help us to construct and build the present and the future on pragmatic scientific basis. Us humanistic past has been valuable, but cannot help much to usher the country into the age of science, invention and rapid economic development. The study of science helps us to understand the natural world and secondly helps us to approach challenges in life and in the workplace in a systematic and logical manner.

Development in the current world is knowledge based on science and technology. We gain knowledge faster through the use of science and technology. More knowledge helps nations to advance faster on the road to increased development and progress. For the country to develop faster, it is important for students to be trained in the processes of seeking answers to problems through scientific investigations and experimentation. The integrated science syllabus is a conscious effort to raise the level of scientific literacy of all students and equip them with the relevant basic scientific knowledge needed for their own living and secondly,

needed for making valuable contributions to production in the country. Education in science also provides excellent opportunities for the development of positive attitudes and values in our youth. These include:

1. Curiosity to explore their environment and question what they find
2. Keenness to identify and answer questions through scientific investigations
3. Creativity in suggesting new and relevant ways to solve problems
4. Open-mindedness to accept all knowledge as tentative and to change their view if the evidence is convincing
5. Perseverance and patience in pursuing a problem until a satisfying solution is found
6. Concern for living things and awareness of their responsibility toward maintaining the quality of the environment
7. Honesty, truthfulness and accuracy in recording and reporting scientific information
8. Love, respect and appreciation for nature and desire to conserve natural balance.

2.7 General Objectives of Integrated Science in Ghana

The general aims for the teaching and learning of integrated science in Ghana are as follows

1 solve basic problems within his/her immediate environment through analysis and experimentation

2 keep a proper balance of the diversity of the living and non-living things based on their interconnectedness and repeated patterns of change.

3 adopt sustainable habits for managing the natural environment for humankind and society

4 use appliances and gadgets effectively with clear understanding of their basic principles and underlying operations

5 explore, conserve and optimize the use of energy as an important resource for the living world

6 adopt a scientific way of life based on pragmatic observation and investigation of phenomena.

7 search for solutions to the problems of life recognizing the interaction of science, technology and other disciplines.

With the above objectives, one vividly sees that the essence of science education is to inculcate in the child the spirit of enquiry that could enable him view all happenings around him in a scientific context. With this, the child that is scientifically literate should be able to explain certain natural phenomena and indigenous practices that occur around them.

2.8 Contemporary Teaching Strategies in Integrated Science

To teach, according to Hornby (2006) is to help somebody to learn something by giving him/her some information about it. Agbulu and Idu (2008) see teaching as an art of disseminating classified information to the recipients by an expert. Bunkure (2013) viewed teaching as the meaningful interaction between the triads; the teacher, the learner and the materials that ensure students gain in the learning process. Thus, from the above definition, one clearly sees that teaching involves the transfer of knowledge from an expert to the learner.

Gero and Ogunnade (2012) observed that teaching is done through different methods. These methods they stress vary from the traditional teacher-centred approach to the contemporary approaches such as demonstration, experimental, discovery and Computer Assisted Approaches. Teachers are expected to choose from the wide range of teaching approaches for the attainment of their instructional objectives. This is because, according to Obeka (2010), teaching method can greatly influence students" academic performance and retention in school subject. Thus, Atadoga and Lakpini (2012) suggested that in selecting methods of teaching, teachers have to take cognizance of learners" age, background, topic to be taught, timing, class size and the available resource at the teacher‟s disposal. Some of the contemporary teaching methods in Ghanaian classrooms are discussed as follows.

Lecture method, otherwise known as expository, teacher centred or traditional method, is the teaching technique in which one person, usually the teacher, presents a spoken discourse on a particular subject to students or an audience (Atadoga & Onaolapo, 2008; Vikas, Prerna, Mushtaq, & Virendra, 2010). Lecture is used to elaborate, simplify, clarify and discuss new materials to learners. The materials may include facts or views on issues or problems related to the learner.

Efficiency of lecture method depends on the type of students, circumstances of the class, the subject, educational purpose, and teachers‘ own characteristics and skills (Bunkure, 2013).

Adesoji (2009) observed that educators have accepted lecture method as a proper way of imparting knowledge. He observed that at least eighty percent (80%) of scientific information or principles are passed on to students through lecture method. (Adesoji, 2009) observed that our educational system puts so much premium on external examinations. Thus, lecture method helps a science teacher to cover a large amount of material (syllabus) to a larger class size in a very short period. This is, however, a detriment to student learning, but the teacher may not have a choice being driven by the pressure to cover the syllabus and thus, prepare students for the external examination, which is the only qualifying measure to the next level or employment.

Lecture method places the authority of the subject matter and the control of the student behaviour on the teacher; making the learners redundant with limited opportunities to express their problems, conflicts, needs, etc. It is difficult to know if the teacher is being understood, there is little chance of correcting students‘ misgivings and, thus, the students are alienated (Kilickaya, 2007). Some other pull backs of lecture methods are listed below:

1. Meaningful learning of science is never promoted as it appeals to only the sense of hearing. Similarly, students are not inspired as to indulge in independent thinking and self-exploration processes.
2. The different ability groups present in any given class are not taken care of. Thus, students who will learn better by handling or manipulating of

instructional materials are completely left out. This can be frustrating for such group of students.

3. It is stressful for students to sit still for a long time at once listening and writing. It can lead to restlessness and disruption of normal class procedure.
4. Talk and chalk (lecture) method encourage only rote learning without necessarily aiding understanding. Students understanding are usually for a short while therefore inhibiting the desired retention.

Series of researches have been conducted to assess the effectiveness of lecture method. However, results of such studies have persistently revealed the weakness of the method. For example, Iyekekpolor and Tsue-Avar (2008) compared Lecture Method with Computer Aided Instruction (CAI). They reported a significant difference in the academic performance and retention of the subjects in favour of students exposed to CAI. Similarly, Olubanke and Ovie (2012) compared peer tutoring teaching approach to traditional teaching method (lecture method) and reported a significant difference in favour of the subjects taught through the peer tutoring approach. Other researches however recommend the teaching approach to higher levels (Vikas, Prerna, Mushtaq, & Virendra, 2010).

The quest for improved academic performance and retention has made researchers to explore different approaches that could be employed to improve students‘ academic status. Thus, several teaching methods were developed to supplement and/or replace lecture method. Some of the teaching approaches include: Guided Discovery, Problem solving approach, Computer Assisted Instruction (CAI), among others.

Although, these methods have been hailed by researchers to provide the needed improvement in the attainment of instructional objectives (i.e. academic performance)

(Olorukooba, 2007a, 2007b; Cooper, Cox, Nammouz, Case & Stevens, 2008; Vikas, Prerna, Mushtaq, & Virendra, 2010; Bunkure, 2008; Bimbola & Oludipe, 2010; Olubanke & Ovie, 2012) it is obvious that these methods have elements of being foreign and therefore subject students to feel inferior. This is capable of affecting their academic performancess (Okwelle & Wali, 2011). This is because, Africans, right from colonization are forced to believe that European cultures are superior while African cultures are in inferior. With this inferiors, academic performances in science continue to dwindle (Okwelle, & Wali, (2011). This is because science teaching has been conspicuously presented with the western view and methods (UNESCO, 2004). As such students hardly understand science as well as make relevance to it with what they encounter daily. Fasehun (2012) cried that indigenous education has been neglected in the Ghana Education system‘s quest for scientific growth. The consequence of which, she concluded, gave rise to multiple societal problems such as corruption, examination malpractices etc. This situation is not peculiar to African or Ghanaian students only; as Matthews and Smith (2006) reported a study that revealed the low performance of Native American students, as measured by standardized tests. The low performances were attributed to a number of factors, including the lack of cultural relevance of curriculum materials used in their instruction. Using a pretest–post-test control group design, Native American students in Bureau of Indian Affairs schools in Grades 4–8 who were taught science using culturally relevant materials achieved significantly higher and displayed a significantly more positive attitude toward Native Americans and science than comparable students who were taught science without the culturally relevant materials. They suggested that when educators of Native Americans teach science, they should use materials that incorporate frequent reference to Native Americans culture and the culture of western science (Matthews & Smith, 2006).

In relation to these inferiors and backwardness in science literacy and scientific growth, Fashiku (2008) quoted Guru Maharaji lamenting the situation as follows:

> *―If you take a man's culture away from him, he becomes powerless; that is what we have found ourselves in. we can't produce, we can't do anything, other than to follow the European theories and philosophies. That is why we are creatively bankrupt".*

Fasehun (2012) therefore concluded that Africans should not forget that to be educated is not to be Eurocentric. What should be done, she stressed, is to fully integrate and harmonize formal education with traditional education so that teachers and learners could be well educated in all ramifications of the world. Similarly, Fleer (2003) argued that when western science is contextualized within indigenous cultural practices in Africa (rather than a complete framework for learning) learning outcomes become greatly improved.

Fakudze (2004) reported that constructivists confirmed that all learning is mediated by learners‟ culture and takes place in a societal context. The role of the social context is to scaffold the learner, provide hints, help the learner and foster construction of knowledge. She buttressed that the effect of socio-cultural background in the teaching and learning of science, is of primary importance if a strong basic foundation is to be established for successful pupils‟‟ performance. Thus, Veal (2001) opined that Africans must find more efficient way of developing and communicating science by reducing their dependency on western science so that they do not become tools of economic exploits. This is in the wake of the call for the, science for all. To do this, Africans in general and Ghanaians in particular must look inwards for effective indigenous practices and knowledge systems (ethnoscience) to communicate science. This study explores the efficacy of ethnoscience-enriched-instruction attitude, retention and academic performance of Basic Science students.

2.9 Science and Culture

According to Nakpodia (2010) Culture is a complex whole which includes knowledge, beliefs, arts, morals, customs and any other capabilities acquired by man as a member of a society. It is the sum total of a given society‘s way of life moulded and shaped by prevailing circumstances and environment. This definition refers to the general process known as enculturation. Enculturation is the process of initiating the growing and inexperienced person into the way of life of his society. Culture is the way of life of a social group and it includes actions, values and beliefs that can be communicated with necessary modifications from one generation to another (Nwegbu, Eze, & Asogwa, 2011).

Nakpodia (2010) stressed that researchers have established the relationship between culture and its effects upon human growth and development and of the effect of socio-economic and social-class influences upon children‘s learning. Thus, Igbokwe (2010) discussing the influence of cultural background in learning science opined that learning science involves making sense of extant knowledge, negotiating meaning, comparing what is known to new experiences and resolving discrepancies between what is known and what seems to be implied by new experiences. This discrepancy is very prominent in Africa where science education has been influenced by cultural beliefs. In Africa, there is (believed to be) conflict between some of the pupils" everyday life-world and the world of science. Igbokwe (2010) for instance has observed that in Africa in general scientific explanation has not been an integral part of the people‘s social life. Rather, power of witchcraft and evil spirit are means of providing explanation to natural phenomena. Culturally, the African child would believe that a baby not crying at birth would mean that the baby is from the evil spirit instead of attributing it to suffocation because of lack of oxygen or malformation in the womb. With this, the African children are not trained to be rational in thought but are encouraged to believe in superstations. At several instances, deviation from a norm by a child or any other person is severely frowned upon. Children (for example) are given factual knowledge about crops, but are not taught the method by which the usefulness of the crops could be evaluated (Obidi, 2005). This underlies the backwardness of science education among African students. This problem is complicated by the fact that the science teaching and learning, introduced by the Europeans, subdued the science the Ghanaian child had experienced. This situation arose due to colonization (Arowolo, 2010).

Arowolo (2010) argued that colonialism, slave trade and missionaries are the bastion of Western civilization and culture in Africa. This is because it was the vehicle of implantation of cultural imperialism in Africa. Colonialism, refers to the imposition of foreign rule over indigenous traditional political setting and foreign dominance and subjugation of African people in all spheres of their social, political, cultural, economic and religious civilizations. With Africa subjugated and dominated, the Western culture and European mode of civilization began to thrive and outgrow African cultural heritage. Traditional African cultural practices paved the way for foreign way of doing things as Africans became fully „westernized". Western culture therefore, secured the regard as frontline civilization. African ways of doing things became primitive, archaic and regrettably unacceptable in public domain. Not only were certain aspects of the material culture in the colonies lost or destroyed, colonized societies also lost the power and sense of cultural continuity, such that it became practically impossible to recover the ability to strive for cultural progress on their own terms (Arowolo, 2010).

The above assertion was corroborated by Kasongo (2010) when he submits that civilization was just another aspect of domination; imposition of new culture over traditional cultural values. Arowolo (2010) therefore concluded that there is need, for the flogging of the negative impact of Western civilization and culture on Africa in all fora; so as to reverse such policies that contribute to the cultural dearth of Africa and hence its education. This study focused and established the impact of the use of African culturally relevant practices (ethnoscience) on Basic Science Students attitude, retention and academic performance.

Notwithstanding the, domination of western culture" on African culture, the African culture should have imbibed the science culture with which the west has brought. However, African culture is not propitious to science and research. This made the African culture to be consumptive rather than productive (Obidi, 2005). Since all cultures are propitious to science, and African cultures are not exceptive, there is the need to explore some cultural practices that are relevant to science with the view to providing good explanation and opening up the door to further research in the field. Hence, the need for present study.

2.10 Ethnoscience and Science Teaching and Learning

Ethnoscience otherwise referred to as indigenous knowledge or culturally relevant science (Hayatu, 2005) is the local knowledge, which is embedded into community and is unique to a given culture location and society. It has also been defined as those cultural practices of a given people that have direct bearing to science or can be scientifically defined. It includes their practices of looking after themselves and their bodies, their botanical knowledge, and their forms of classifications (Sutherland & Dennick, 2002; Hayatu, 2005; Jerie & Matanga 2011). Ethnoscience is a term and study that came into anthropological theory in the 1960s. Often referred to as "indigenous knowledge," it introduces a perspective based on native perceptions. Ethnoscience looks at the intricacies of the connection between culture and its surrounding environment (Abonyi, 2002).

Ethnoscience/Indigenous knowledge is the knowledge used by local people to make a living in a particular environment (Jerie & Matanga 2011). The terms used in the field of sustainable development to designate this concept include: indigenous technical knowledge, traditional environment knowledge, rural knowledge etc. such knowledge is creative, experimental and innovative in order to meet the need of changing conditions. Ethnoscience has the capacity to blend with the knowledge-based science and technology thereby complimenting scientific and technological efforts to solve problems associated with understanding science concepts. Udofia, (2009) observed that the linking of science teaching to day-to-day activities of the learners will actualize and expand the learning process in the following ways:

1 Better understanding of concepts;
2 Enhanced creativity in learners;
3 Establish connection between theory and practice;
4 Serves as bridge between classroom and environment;
5 Reduces the abstract idea associated with science (Udofia, 2009).

Njoku (2007) supported that science teachers should link the learners already known information (prior knowledge) to information to be learnt. Olorundare (2006) also opined that the teacher should use such knowledge by giving many examples from the environment. This will make learners get acquainted to science concepts and could improve their understanding of scientific concepts. Generally, indigenous knowledge involves such knowledge that is specifically adapted to the requirements of local people and condition. It is also creative, experimental and innovative to meet new conditions.

Ethnoscience is a specialization of indigenous knowledge systems, such as Ethno-botany, ethno-zoology, ethno-medicine, etc. (Ingold, 2000). He further explained that ethnoscience looks at culture with a scientific perspective. Ingold (2000) stressed that although most anthropologists abhor this definition. Hayatu, (2005) observed that ethnoscience helps to understand how people develop with different forms of knowledge and beliefs, and focuses on the ecological and historical contributions people have been given. Ingold (2000), describes ethnoscience as being a cross-discipline. He concluded that ethnoscience is based on increased collaboration between social sciences and humanities with natural sciences.

Despite these assertions by scholars that science is related to culture, instructional processes (in Ghana and other African countries) are treated as foreign.

Thus, teachers and students see no relationship between science, environment and their culture (Chuku, 2009). Considering the foreign nature in which science is portrayed, Uduchukwu (2006) stressed that students should be made to understand that chemistry is not a white man magic! But it is something that everybody experiences in his or her everyday life. On this note, Okebukola (2002) posited that meaningful application of science in relation to the learners‟ everyday life will reduce forgetfulness in learners and also enhance their creativity.

Aikenhead (2002), Nakpodia (2010), Jerie and Matanga (2011) also stressed that scientific knowledge has been enriched by the pooling of understanding from different cultures - western, eastern and indigenous cultures including those of Aboriginal peoples and Torres Strait Islanders - and has become a truly international activity. Aikenhead (2002) highlighted that the „education for all" program of the *Asia*-Pacific Centre of Educational Innovation for Development (Aikawa, 2004) observed that the following two ideas are relevant to Indigenous peoples as participants are in the pursuit of a scientifically literate society:

- Diversity: ―Each country has a unique culture (and within the national culture, many sub-cultures) which, if shared, may possibly benefit and enrich each other." (Aikawa, 2004)
- Equality: ―... there are also other population groups who, by virtue of language, ethnicity, geographical location, or economic status, are underserved by education systems." (Aikawa, (2004)

This underscores the need for effective curricular in the school systems of non-western nations. In contrast however, Ryan (2003) observed that curriculum development in some developing countries is being undertaken as a global project rather than inclusive of the needs, policies and their cultures. He narrated an experience of how expatriate education consultants in Papua New Guinea have developed and were implementing a science curriculum which bears the hallmarks of a globalised curriculum with limited acknowledgement of the needs of the indigenous population. At the same time Bell (2003) revealed that initiatives such as the Maori science curriculum in New Zealand that have been initiated, their uptake by students, teachers and schools have still been eclipsed by the western curriculum (Bell, 2003).

This reflects hegemony of western science in the curriculum of developing countries. The influences of a globalised science curriculum on indigenous peoples have been documented by science education researchers in Africa, Asia, the Caribbean and the South Pacific.

Kyle (1999) observed that scientists no longer need to make comparisons between different kinds of knowledge in Western and non-Western cultures. He concluded that science educators must acknowledge that multiple knowledge (i.e., knowledge from the child‘s home and that of the modern science) exist and it is incumbent on all cultures to contribute in meaningful ways to the development and environmental sustainability of our global community. Based on the above comments and several others reasons, Science educators continued to explore avenues to inculcate indigenous practices and knowledge from the non-western cultures into science. They observed that the two knowledge systems (ethnoscience/indigenous science and western science) are distinctive fields that present the learners a varying viewpoint. Aikenhead and Jegede (1999) observed that for a student to acquire a culture of science, he/she must travel from his/her everyday life-world to the world of western science, this western science that is found in classroom which is usually in conflict with the learners‟ indigenous knowledge and/or seem to be more superior to the child‘s indigenous knowledge.

With the above superiors Aikenhead and Jegede (1999) observed that clashes occur between pupils‟ life-world and the world of Western science. In response to such hazards, pupils understandably invent ways to avoid constructing scientific (―foreign") knowledge, or pupils conveniently store the constructed scientific knowledge in such a way that it does not harm or interfere with their lifeworld experiences. The cultural clashes between pupils‘ life-worlds and the world of

Western science present a challenge to science educators. Specifically, they make science teaching a Herculean task and the meaningful learning of science an ordeal for many pupils (Aikenhead, 2002; Fakudze, 2004).

To address this problem, science educators proposed theories/hypothesis which emanate from the worldview theory to explain how students move between their everyday life worlds and the world of science; and how they deal with cognitive conflicts between the two worlds (Fakudze, 2004) with a view to enlightening teachers to help learner effectively learn science. Three of these theories are:

i. Border crossing theory;
ii. Collateral Learning Theory;
iii. Contiguity learning Hypothesis.

2.10.1 Cultural border crossings

In the context of teaching science for all, Aikenhead and Jegede (1999) described the act of cultural border crossing into school science and its cognitive explanation (collateral learning). They drew upon cultural anthropology which regards the learning of science as the acquisition of the culture of science. They opined that to acquire the culture of science, pupils must travel from their everyday life-world to the world of science found in their science classroom.

Aikenhead and Jegede (1999) observed that the capacity to think differently in diverse cultures (every day culture and science cultures, for instance), and the capacity to resolve conflicting beliefs between those cultures, are familiar human traits. They concluded however that, these capacities are not equally shared among all people. Thus, Fakudze, (2004) elaborated Aikenhead and Jegede‘s border crossing as a situation where one moves from his home culture to that of school. He summarized the differences in the individuals into four different categories of border crossing viz:

1 Smooth border crossing;
2 Managed border crossing;
3 Hazardous border crossing;
4 Impossible border crossing.

Fakudze explained that smooth border crossing occurs when the learners" worldview is congruent with school science. In other words, such students are potent Scientists whose home cultures and western science culture are congruent. Managed border crossing involves students whose worldview is different from the science worldview Thus, requiring the transition from the culture of his/her worldview to that of science. Hazardous border crossing occurs when the students' worldview and scientific worldview are rather diffused (Fakudze, 2004). Aikenhead and Jegede (1999) identified them as ―I Don't Know" Students. Impossible border crossing occurs when the students" worldview and that of science are highly discordant causing the students to resist transition from one worldview to another. Jegede and Aikenhead (1999) called them „Outsiders" with virtually discordant cultures from that of western science.

From the above categorization Aikenhead and Jegede in Fakudze (2004) observed that one overwhelming conclusion emerges from educational research in cultural anthropology that success in science subjects teaching and learning depends on:

1 The degree of cultural difference that pupils perceive between their life-world and their science classroom,

2 How effectively pupils move between their life-world culture and the culture of science or school science, and

3 The assistance pupils receive in making those transitions easier.

This assistance is therefore in a way of presenting learning materials to students that relates to their worldview (cultural environment) through ethnoscience.

2.10.2 Collateral Learning and Science Teaching

Collateral learning theory as proposed by Jegede and Fakudze; (2004) is a mechanism to explain how students harmonise the conflict resulting from a traditional world view and that of science. He asserts that a student in a science classroom will construct scientific concepts side by side, and with minimal interference and interaction, with their indigenous concepts (related to the same physical event). Jegede and Fakudze (2004) states that there are variations in the degree to which the conflicting ideas interact with each other and the degree to which conflicts are resolved. Four types of collateral learning were identified which include parallel collateral learning, secured collateral learning, dependent collateral learning, and simultaneous collateral learning. Fakudze (2004) observed that even though collateral learning theory has identified the different types of collateral learning experienced by students, it has however not described how the students acquire each one of them. It is however not the aim of this study to establish how students acquire the different collateral learning types, but to bring the constructs to fore so as to enable teachers get aware of them and know how to tackle them in situations they arise.

2.10.3 Contiguity learning hypothesis and science teaching

In addition to the four border crossing categories, as outlined by Aikenhead and Jegede (1999), Ogunniyi (2002) further proposed the contiguity Learning Hypothesis. The hypothesis depicts border crossing as a dynamic rather than a fixed process. it proposes that border crossing depends to a greater extent on the context and interest being served. Hence the type of border crossing that occurs depends on a host of factors which include:

1 The consequence of a given response;

2 The interest or satisfaction derived from a learning experience; and,

3 The desire to gain a mastery over a learning task.

Fakudze (2004) explained that the contiguity learning hypothesis uses psychological and philosophical explanations to explain the process of border crossing from traditional belief and commonsense experience to that of school science. The essence of the border crossing is to bring to fore the challenges that are likely to occur in the learners when exposed to science concepts using a different scenario from the one they are used to. This is because, the lack of expectation in the application of culturally relevant practices in teaching could bring about mixed feelings among students. Thus, the understanding of this will enable teachers to help learners navigate the ―maze" and attain meaningful learning.

From the foregoing theories and hypothesis, it is explicit that learning science by students from non-western nations is being challenged by the task to imbibe western science which most at times are in conflict with their traditional worldviews and requires some special treatments to ―bridge" the two worldviews. To effectively do this, Jegede and Fakudze (2004) developed the ecocultural paradigm in which ―the growth and development of an individual‘s perception is drawn from the sociocultural environment in which the learner lives and operates" and consists of;

1 generating information from the African environment to explain natural phenomena;

2 identifying and using the indigenous scientific and technological principles, theories and concepts within African society;

3 teaching the values of the typical African humane feelings in relation to, and in the practice of, technology as a human enterprise.

George (1999) identified a number of critical issues in the context of teaching students with alternative cultural backgrounds conventional science, to:

i. enculturate students into science with the hope that some would become future scientists and make contribution to national development in the areas of science and technology

ii. provide students with enough Basic Science to allow them to improve the efficiency of their indigenous technologies and to be more ―scientific" in their day-to-day living

iii. provide a teaching/learning situation in science that makes it possible for students in traditional settings to have easier access to science through overt comparisons of their world view with that of science, so that they would be in a better position to evaluate the likely contribution of science to their lives.

Success in science depends on teachers helping pupils mediate or negotiate cultural borders and engage in some form of collateral learning. Thus, the teacher's role is to resolve the cultural conflicts that arise in cross-cultural education. A science teacher who is a culture broker will guide pupils between their life-world culture and the culture of science, and help them resolve any conflicts.

Based on the foregoing, this study is set to find out the effects of culturally relevant science (ethnoscience) on students‟ academic performance by providing a learning situation using the cultural/traditional background of the learners.

2.11 Sefwi Cultural Practices of Ethnoscientific Relevance

In the extreme north of the Western Region of Ghana are three traditional states collectively known as Sefwi. Sefwi is made up of three mutually independent paramount clans of Anhwiaso, Bekwai and Wiawso. It is bounded on the north east by Ashanti (Asante), on the east by Denkyira and Wassa Amanfi, on the south by Awowin and on the west by the Anyi - Baule of the Ivory Coast. It also shares a common boundary with Brong Ahafo in the north. All the three states share a Common dialect Sefwl but almost all the people speak Twi (Akan). In addition, they have a common tutelary deity, Sobore, and a Common annual yam festival called ―Allelolle".

The tribe has a wide range of cultural heritage of scientific relevance. Some of the practices that could be used to explain certain scientific concepts are shown in figure 2 – 6 and table 1

The practices are presented in pictorial forms in the following plates.

Fig 2: Black Smith Heating a Metal

Fig 3: Black Smith Shaping a Heated Metal

Fig 4: A Girl Carrying Calabash Freely on her Head

Fig 5: Butcher Inflates an Animal

Fig 6: A Woman Winnowing to Separate Grains from chaff

Table 1: List of Sefwi Cultural Practices of Scientific Relevance

Cultural practice	Area of scientific relevance
Addition of potash into sour soup	Neutralization reaction
Addition of nails into pots when cooking animal skin	Catalysis
Fishermen floating on calabash	Density
Soap making	Saponification
Addition of ash into pit latrine	Neutralization reaction

2.12 Students' Location and Academic Performance in Integrated Science

Environment or location is an important factor that affects students academic performance as reported by researchers. Location/environment refers to the place where something exists (Hornby, 2006). Location is therefore the environment in which a student grows and/or schools in.

Generally, the society in which an individual or learner lives is classified into urban and rural centres (Yusuf & Onyeuwotu, 2014). The definitions of these two major classifications are diverse. The Centre for Rural Education and Community (2014) observed that, while there is no one agreed-upon definition for what constitutes a ―rural and urban" settlement, most methods of classifying territory along an urban rural continuum make reference to population size and density, level of urbanization, and/or the relationship to urbanized areas in terms of economic activity, commuting patterns, and so on. Owoeye and Yara (2011) conceptualized urban environment as those environments which have high population density, containing a high variety of beauty and common place views while the rural environment as being characterized by low population density containing a low variety and isolated place views.

However United Nations (2013) pointed out that population size adopted for classifying settlements varies greatly from one country to another. Population considered large enough for qualifying a settlement to be classed as an urban centre in one country may be regarded as too high or too low in another. In Denmark, for example, settlements with more than 200 have been taken as a critical point; in USA the figure is 2,500; in Ghana it is 5,000 and in Greece, Spain and Switzerland it is 10,000. National Population of Nigeria, cited in Oyeleye (2001), defines an urban centre in the country as any settlement with at least 20,000 people. Reason given for the adoption of this figure was that only a population of that size can utilize at optimum level such essential services as higher institutions, hospitals, police station, banks, secondary schools, telecommunication services and supermarkets or chain stores country.

According to Olayiwola (2015) some definitions of urban and rural settlements are based on the livelihoods of their inhabitants and is reduced to two main categories: agriculture based in rural areas, and a reliance on manufacture and services in urban centres. This definition underscores that rural areas are mainly agrarian while the urban areas are industrial. Oyeleye (2001) stressed that rural areas have less population than urban centres; while human activities in rural areas are largely oriented towards primary (agrarian) production, they are largely secondary and tertiary in urban areas. He concluded that on a general note, farms, hamlets, and villages are considered as rural settlements while towns, cities, metropolis and megalopolis are classed as urban centres (Oyeleye, 2001).

However, despite the population of the inhabitants of the rural areas, a critical analysis of locational factors, surmised that provision of education in rural areas is normally fraught with the lot of difficulties and problems because qualified teachers refuse appointment in isolated villages; villagers refuse to send their children to schools because they are dependent on them for help; parents hesitate to entrust their daughters to male teachers; some villagers have few children for an ordinary primary school; lack of roads or satisfactory means of communication makes it difficult to get books and teaching materials to the school which place difficulties in the way of organizing school transport among others (Owoeye & Yara, 2011).

The relationship between school location and student academic performance in science has been widely reported. Jekayinfa (2014) observed that environment in which a child lives has significant influence in the development of child‘s cognitive abilities and affective characteristics. She observed that negative learning environment hinders learning. Several researches have reported that academic performance varies with location (Habib, 2003; Uju, 2006; Ferguson, 2009). Adepoju, (2001) found that students in urban schools manifest more brilliant performance than their rural counterparts.

Michigan (2013) observed that students" performance is greatly affected by the area in which a student lives. Reasons for the variations in performance are geographic location, resources, availability of technology, and quality of teachers. Historically, rural areas have lagged behind urban and suburban schools in educational performance. Adepoju, (2001) found that students in urban schools manifest more brilliant performance than their rural counterparts. Also, Ogunleye (2002) reported a significant difference in the performance of students in urban and semi-urban areas. However, Ogunleye (2002) did not find any significant difference in the urban and semi-urban schools. Tayyaba (2012) observed that recent educational research has demonstrated rural-urban gaps in performance and schooling conditions. She observed that evidence from developing countries is still sparse. She therefore conducted a study in Pakistan to have bases to the recommendations to developing countries. The results showed that rural and urban students had comparable levels of performance in some of the tested learning areas. She attributed the differences (in the non-comparable areas) to be partly explained by variation in schooling conditions and students' home backgrounds.

Although most researchers found rural schools as being detrimental to student performance, Michigan, (2013) observed that the rural schools have proven to be advantageous for several reasons. First of all, the small size of rural schools helps enhance students‟ performances. Additionally, rural schools tend to have low student/teacher ratios, which allows for more individualized attention and assistance in areas of student difficulty. Brown and Swanson in Michigan (2013) observed that one strategy that rural schools are inclined to using is group learning. This strategy allows the students to work with one another and benefit from group discussions and various opinions. Furthermore, many rural schools have strong ties with their community. Because of this, students feel comfortable in their school, and are at their maximum potential for learning.

The studies of Habib (2003) reported that urban students did better than their rural counterparts in mathematics. However, Lee and McIntire (2001) conducted research on rural and urban academic performance of students in elementary schools and found substantial variations in average performance of rural and urban schools in mathematics. In some instances, rural students scored significantly higher than urban students, where as in others, rural students scored significantly lower. These findings challenge the view of rural mathematics students‟ performance as necessarily lower than urban students‟ performance. Though, Williams (2007) opined that in order to confirm the presence of a rural effect, it is useful to control for socioeconomic status at individual and at aggregate school levels. When this is done, it is possible to observe if effects of rural location on mathematics performance are significant, once the effects of individual and school-level have been removed (Williams, 2007).

Chauhan, (2007) observed that for effective learning, learning experiences and other activities must be meaningful and understandable in terms of the personal life of the learners. Thus, he stressed that teachers should make their lesson materials meaningful if they want their students to retain what they teach. In view of these conflicting reports, this study examined the impact of ethnoscience-enriched instruction and determined which of the students‟ location provided advantages to learners.

2.13 Instructional Strategy and Students Retention Ability

Permanent and meaningful learning are ultimate target of every educational endeavour (Chauhan, 2007). Understanding and retention are products of meaningful learning when teaching is effective and meaningful to the students (Bichi, 2002). Permanent learning is referred to as retention. Retention according to Hornby (2006) and Chauhan (2007) is the ability of an individual to remember things.

Retention is the ability to retain and consequently remember things experienced or learned by an individual at a particular time. It takes place when learning is coded into memory. Thus, the appropriate coding of the information provides an index that may be consulted so that retention can take place without an elaborate search in the memory lane (Bichi, 2002). The nature of material to be coded contributes to the level of retention especially when they are meaningful, familiar, and present correct image of the concepts to learners (Muhammad, 2011). Muhammad (2011) further explained that retention is base model for which meaningful stimuli are processed by the brain at a deep level. This model is attributed to the long term memory (retention) which enables learners to process semantic knowledge deeply by associating recall items with what they already know.

Several factors are known to influence retention. Muhammad (2011) stressed that anything that aid learning should improve retention while things that lead to confusion, or interference among learning materials decrease the speed and efficiency of learning and accelerates forgetting.

Studies on retention and instructional strategy have attracted the attention of researchers like, Ezema and Dung (2003) who compared the effectiveness of concept mapping and guided discovery teaching strategies on students" retention of some chemistry concepts. Results of the study revealed a significant difference between the concept mapping and guided discovery post-test scores in favour of concept mapping. It follows that the concept mapping method enables students to have better understanding of concepts taught and retain more knowledge of chemistry concepts than the guided discovery method. Tahir (2005) compared and determined the more effective approach by use of Information and Communication Technology (ICT) on performance and retention of secondary school students of mathematics in Pakistan.

He compared three approaches to classroom teaching: The Computer Based Instruction (CBI), Computer Based Learning (CBL), and the Teacher Centred TC) approach. He found that there is a difference in retention among the groups of the students taught mathematics through CBI, CBL and TC approaches. It was found that the CBL group had significantly scored higher in performance test and as well had better retention of the content of mathematics taught to them during the experiment. He also reported that the female students showed some significant improvement in retention as their overall score was considerably higher than the boys in delayed-post-test. It was concluded that the use of CBL approach in teaching of mathematics at secondary level in Pakistan can be encouraged for better performance and retention of the subject.

Akinbobola and Folashade (2009) compared the effectiveness of constructivists teaching method and the conventional method with reference to performance, retention and attitude. They found that students exposed to constructivist teaching method have higher cognitive performance, more positive attitudes and higher retention level than their counterparts taught using the conventional teaching method. Similarly, Muhammad (2011) studied the impact of inquiry teaching method on academic performance, retention and attitudes towards chemistry among diploma students of Kano State Polytechnic and reported a significant effect on students‟ academic performance in both male and female students.

From the above cited studies, it is evident that innovative teaching strategies have the capabilities of enhancing learners‟ retention in science related disciplines. But these innovative strategies either require expensive materials or require some technical expertise. Thu, teachers shy away from them. There is therefore the need for a more familiar instructional strategy that teachers can employ with ease to enhance students‟ academic performance, improve their attitude and retention of science concepts. This study investigated the impact of ethnoscience-enriched instructional strategy at enhancing student retention of Basic Science concepts.

2.14 Students' Attitude and Academic Performance in Science

Sola and Ojo (2007) and Akinbobola & Ikitde (2008) defined attitude as beliefs and opinions that can predispose individual to behave in certain ways. Thompson & Peni

(2008) and Foley and Mcphee (2008) sees attitude as opinion or way of thinking, or the behaviour reflecting the way of thinking. Attitudes are related to believes and opinion that can predispose individual to behave in certain ways. In a nutshell, the above definitions stressed attitude to comprise of cognitive and affective components. Sola and Ojo (2007) posits that attitudes are important at influencing students‟ acceptance or rejection of situations. Attitudes influence behaviours and have implications for learning as observed by Kay and Muhammad (2011). Attitudes are significant predictors of effective learning Akinbobola and Ikitde (2008). Thus, the kind of attitude a child has, affects his school work and learning. If a child has positive attitude about teachers and like school work, he will experience some success and will work more effectively.

Attitude associated with science affects students‟ performance in science as a subject. Azure (2009) studied the effect of self-image and attitude as predictors of students‟ performance in Basic Science at the tertiary level. Results showed that there were statistically significant relationships between performance and high self-image, perceived importance of science, and dislike for the subject. Adesoji (2008), Foley and Mcphee (2008) reported that students' positive attitudes to science correlate highly with their science performance.

Similarly, researchers have established that students have negative attitudes towards science and science related disciplines. Eze in Bunkure (2008) observed that students show lukewarm attitude towards science. Some students have preconditioned their minds on their incapability to learn science and even propagated some beliefs of its difficulty thereby discouraging others (Sola & Ojo, 2007). Also, these beliefs have affected the attitudes of students towards learning science. He also stressed that certain science concepts are perceived difficult by most students; this affects their performance (Akinbobola & Ikitde, 2008).

Cracker (2006), and Akinbobola and Ikitde (2008) concurred that research has shown that a person‘s attitudes are learned; as opposed to being inherited Thus, it can be changed through persuasion using a variety of techniques. Many factors can influence a person‘s attitude, including previous experiences and social influences. (Akinbobola & Ikitde, 2008). The type of science courses taken, previous science experiences, science teachers, and various other factors can influence these attitudes toward science. The impact of a student‘s attitude toward science is incredibly important. Cracker (2006) reported a steady decline in students‟ interest to science in the United States due to the instructional strategy employed by their teachers. Similarly, expected performance is another factor that is heavily influenced by attitudes towards science. As would be expected, positive attitudes toward science lead to better results on performance in science (Akinbobola & Ikitde, 2008).

In addition to performance, previous experiences in science can heavily correlate with a student‘s attitude toward science. Research has demonstrated that, attitudes toward science change with exposure to science, but the direction of change may be related to the quality of that exposure (Cracker, 2006).

Other factors that may influence attitude is the students‟ home background and peer influence. The effect of peer group on students‟ attitude if not properly managed, can change the students‟ predisposition to any subject (including science). Ogunsola-Bandele (2001) opined that the choice of subject has some relationships with the social background of the parents; i.e., if the parents are educated, they will encourage their wards to take up science subjects. Thus, it is expected that the home a child comes from, influence his/her attitude towards science.

Another societal influence that affects attitude and enrolment into science subject is the gender stereotyping of science (Ogunsola-Bandele, 2001). In most Ghanaian societies, science is seen as a males‘ activity and ―no go area" to the females. Some activities are considered ―abnormal" for female but normal for males.

These societal perceptions of normal and abnormal sex roles influence female attitude and participation in science. Issues of gender role, stereotyping, gender division of labour, discrimination, glass walling, sticky floor, as coined by Akanbi (2004) are factors that immensely affect female participation in science. Similarly, lack of self-esteem, poor self-image and non-assertive behaviour are among the factors that make the girl child to shy away or perform poorly in school science (Ogunsola-Bandele, 2000;FAWE, 2000). Another factor as observed by Ogunsola-Bandele (2000) is the involvement of mathematics in science. She opined that majority of the female will rather do without mathematics aspects (Ogunsola-Bandele, 2000; Olayiwola, 2000). The girls also under estimate their ability and believe boys to be superior to them (FAWE, 2000).

Researchers like Ogunsola-Bandele (2000) and Chimezie (2001) Observed that girls usually begin with positive attitude and enthusiasm towards science, but their interest diminishes as they proceed in the programme. This change was attributed to the fact that they do not experience science through activities relevant to their concerns. With this, Chimezie (2001) stressed that instructional materials and good instructional strategies are important at enhancing girls‘ participation in science especially when they are introduced to them at their tender age through manipulative toys that allow making connections to their home endeavours.

Achor, Imoko, & Uloko (2009) also studied the effects of Ethnomathematics Teaching Approach (ETA) on senior secondary students" performance and retention locus. The results revealed that students taught using ETA had higher retention than those taught with the conventional approach. They argued that the higher performance by the ETA taught group was because the group was able to integrate or link their background knowledge/indigenous knowledge to the new concepts they were taught. Similarly, Iji (2004), Uloko and Ogwuche (2007) and Chianson (2008) reported that innovative instructional processes are effective at enhancing learner retention. Thus, Achor, Imoko, and Uloko (2009) concluded that academic performance and retention in science and mathematics depend on the approach of instruction. Achor, Imoko and Uloko (2009) conducted this study in mathematics, what will therefore be the effect of ethnoscience-enriched-instruction on students" academic performance, attitude and retention of Basic Science concepts? This study focused on this area.

2.15 Implication of Literature Reviewed on the Present Study

Ghana believes that an effective science education needed for sustainable development should be inquiry-based. Thus, science education must provide learners with opportunities to expand, change, enhance and modify the ways in which they view the world. It should be pivoted on learner-centred science teaching and learning approaches that engage learners physically and cognitively in the knowledge-acquiring process in a rich and rigorous inquiry-driven environment.

Also, the main aims of integrated science learning in Ghana are to:

1 Develop the spirit of curiosity, creativity, innovation and critical thinking for investigating and understanding their environment.
2 Develop skills, habits of mind and attitudes necessary for scientific inquiry.
3 Communicate scientific ideas effectively
4 Use scientific concepts in explaining their own lives and the world around them.
5 Live a healthy and quality life.
6 Develop humane and responsible attitude towards the use of all resources of Ghana and elsewhere.
7 Show concern and understanding of the interdependence of all living things and the Earth on which they live.
8 Design activities for exploring and applying scientific ideas and concepts.
9 Develop skills for using technology to enhance learning.
10 Use materials in their environment in a sustainable manner.

However, the smaller number of students that enrol into science schools end up with poor results. These poor performances affect or influence their attitude towards science and science related discipline. The situation is not limited to them as their successors sighting their failure, get scared and thus, run away from science.

Crave for improvement in the quality of science teaching is one of the major concerns to science educationists and teachers. With the growing number of failure and loss of interest in science subjects, science teachers ventured into various investigations to identify the possible causes of the problem. The chief problem identified by such researchers as responsible for the poor performance and enrolment in science is the nature of instructional procedure employed by teachers in presenting science contents to students. The predominant teaching technique is the lecture/expository/talk-chalk teaching method. This method has been criticized by various scholars as not having the potentials to facilitate learning. This is because of its portraying the teacher as the master of knowledge as well as lack of practical activities that could bring hands-on and minds-on experiences to the learners. Hence the scholars advocate for innovative approaches to better teaching of science concepts.

Researchers have also raised observations in the foreign nature by which science is being presented to the learner devoid of examples from the learners‟ home environment. Several researchers viewed that this situation makes the learners experience worthless and therefore presenting him/her an entirely new field that is detached from his „world view‟. This detachment creates a cognitive conflict and poses challenges to learners. Some scholars opined that there is need to incorporate the learners‟ cultural heritages into the instructional process in science. They feel that doing this will reduce the cultural gap between the learners‟ culture and the culture of „western science‟. However, some scholars felt contrary to this and observed that cultural science or indigenous science were a-scientific.

There are wide spread speculations that the introduction of ethnoscience concepts into the science classroom could bridge the gulf between the culture of the learner and that of the modern or western science. A contradictory view was however shared by some anthropological scientists that indigenous knowledge or cultural practices were primitive and are capable of generating more conflicts in learners when incorporated into science instruction. These believes stem from the feeling that indigenous knowledge/ethnoscience has no relationship with advanced scientific knowledge and therefore unnecessary in science instruction. These speculations are however not backed up by empirical evidence in which case, the exact role or implications of the infusion of the ethnoscientific processes in classroom instructions on students" academic performance, retention and attitude to Basic Science is still in doubt.

Similarly, researchers have established the disadvantaged position of the female gender in science and science professions. This is due to their underperformance and enrolment into science. As it is believed, girls are faced with gender stereotype as well as sex related roles in the society. These sex roles prevent female students from participating in science. Researchers have, however, proven that this stereotype could be abolished when the culture of the learner is incorporated (Mari and Peni, 2010). Therefore, since ethnoscience is related to the learners" home environment, this study examined its impact on the improvement of students' attitude, retention and academic performance among female Basic Science students.

Another important variable of interest to this research was the location of the learners. The influence of the learner's location on performance has been documented. Research findings provide that the urban students are at advantage to the rural students. The differences in cultural inclination among students in the urban and rural areas are also documented. This is because, the influence of modernization is more on students in the urban areas compared to those from the rural areas. This study addressed this rural- urban drift by exposing students to science instructions using relevant cultural practices through ethnoscience-enriched-instruction.

CHAPTER THREE

METHODOLOGY

3.0 Overview

This study investigates the impact of Ethnoscience-enriched-instruction on attitude, retention and academic performance of JHS 2 students in urban and rural areas of Sefwi Wiawso Municipality. The chapter describes the methodology that was employed in carrying out the research. It is presented under the following subheadings. Research Design, Population of the Study, Sample and Sampling Technique, Selection of Basic Science Concepts to be Taught Instrumentation, Administration of Treatment, Data Collection Procedure, Procedure for Data Analysis.

3.1 Research Design

This research adopted the quasi-experimental design. It employed a Pretest, post-test quasi-experimental control group design. The study involved experimental group that were taught Integrated Science concepts using ethnoscience-enriched-instruction (Appendix A); and a control group taught Integrated Science concepts with the lecture instructional method (Appendix B). The groups were pretested (before the treatment) to ensure that they did not differ significantly in their academic performance before the treatment. A four - week treatment was given to both experimental and control groups.

At the end of the treatment, a post test using the same instrument used in the pretest was administered to assess the students‘ academic performance due to the treatment.

Two weeks later, a post-test was administered to assess the extent of retention of the concepts learnt

3.2 Population of the Study

The population of the study comprised 131 JHS 2 pupils from four selected public basic schools in the Municipality. The average age of the students is 15. The details of the schools and population are in Appendix C. the summary of the characteristics of the population is presented in Table 2.

Table 2: Population of the Study

The four	**Schools (General)**	**Urban schools**	**Rural schools**
Gender	**No**	**Population**	**Population**
Male	71	39	32
Female	60	34	26
Total	**131**	**73**	**58**

3.3 Sample and Sampling Technique

Eleven schools were randomly selected by the researcher initially using “draw from the hat” method for the study and were subjected to a standardized pre-test adopted from BECE past questions. The results of the pretest from the 11 schools however, were subjected to Analysis of variance (ANOVA). The schools that had no significant differences were finally selected for the study. The schools selected were randomly assigned into experimental and control groups from both urban and rural areas. The summary of selected schools is presented in Table 3

Table 3: Sampled Schools for the Study

Sn	Name of school	Location	Sampled size	Group
1	Sefwi Domeabra D/A J.H.S	Rural	28	Experimental
2	Wiawso R/C JHS	Urban	35	Experimental
3	Watico experimental JHS	Urban	38	Control
4	Ayinabriem JHS	Rural	30	Control
	Total		**131**	

3.4 Selection of Integrated Science Concepts to be Taught

For the purpose of this study, topics in the theme that were perceived difficult by Integrated Science teachers and students (Ogunkola & Samuel, 2011) were selected mainly from list of topics. Specifically, topics were taken mainly from year 2 contents. The selected topics are.

i. Acids and Bases

ii. Forces

iii. Density

iv. Digestive system

v. Osmosis

vi. Mixture

Ogunkola and Samuel (2011) reported varied perception of difficulty on Integrated Science topics. Similarly, Peni (2013), observed that most of the topics were either omitted or partially touched in Basic Education Certificate Examination for five consecutive years. Ogunkola and Samuel (2011); Edu and Edu (2013). Observed that the difficulty could be due to the nature of perception the students portray towards the subject. They further stressed that Research literature from countries around the globe provided evidence of much commonality in the types of problems and issues confronting science education, especially at the junior and senior high school levels.

3.4.1 Instrumentation

Three instruments were used for the study; these are:

i. Integrated Science Performance Test (ISPT)

ii. The Students Attitude/perception to Integrated Science Questionnaire (SAISQ)

iii. The Instructional Instrument (Lesson Plan).

3.4.2 The Integrated Science Performance Test (ISPT)

The Integrated Science Performance Test was developed by the researcher based on the selected topics to be taught and test blue print (table 3.3). The test is made up of two sections (A and B). Section A sought for the students' personal information like sex, names, age and location of school. Section B contains 30 multiple choice (objective) tests. The ISPT was developed based on the steps outlined by Sambo (2005). In developing the instrument, Sambo (2005) suggested that the researcher should develop more items than will be required to allow for the selection of good test items. Thus, forty multiple choice items meant to assess the extent of the attainment of the students' academic performance were developed. The items of the instruments were subjected to a pilot test to enable the selection of items with good difficulty and discrimination indices.

Table 4: Table of Specifications (Test Blue Print) for ISPT

Content Topics	Knowledge	Process Objectives Comprehension	Application	Total
Acids and bases	2	1	1	5
Forces	2	1	2	5
Density	1	1	1	4
Digestive System	2	2	1	5
(Osmosis)	2	1	2	3
Separation Techniques	1	1	1	3
Total	**10**	**7**	**8**	**25**
%	**40**	**28**	**32**	**100**

3.4.3 Questionnaire

In addition, all the students were give students Attitude/perceptions towards Integrated Science Questionnaire (SASQ). The students' questionnaire items were chosen to gather data about students' attitude/perceptions towards Integrated Science. Questionnaire is the most widely used instrument for data collection (Asabere – Ameyaw & Haruna, 2007; Muijs, 2010). The general benefits of a questionnaire include, consistency of presentation of questions to the respondents, the assurance of anonymity for the respondents and the less time it takes administer (Fraenkel & Wallen, 2000; Alhassan, 2006; Muijs, 2010). This was managed wih open – ended items which presented opportunity for respondents to formulate their own answers. Closed – ended items made responded to choose between answers of the researcher. According to Oppenheim (2000), both open and closed ended items in questionnaire provide a greater depth of responses.

3.5. Validity of the Main Instruments

Validity determines whether the research instrument truly measures that which it is intended to measure. In order to make sure that the instruments were valid, they were given to the researcher‘s supervisor and other senior lecturers who went through and gave the necessary suggestions and corrections to ascertain the content and face validity of the items.

3.6. Pilot Testing the Integrated Science Performance Test (ISPT)

The ISPT was pilot tested using a randomly selected schools that were not be used for the main study (Sefwi Boako D/C JHS and Sefwi camp D/C JHS). The pilot test was to enable item analysis for the test items, and used to ascertain their difficulty and discrimination indices. Thus, 50 students (25 males and 25 female) were selected from the schools which has students from both urban and rural areas due to their nature and location.

The students were subjected to ethnoscience-enriched-instruction by the researcher. The teaching was conducted for two weeks after which the thirty items of ISPT were administered and timed, the average time taken by the students to respond to the forty items was 40 minutes.

3.6.1 Facility Index (FI)

Facility index or Item difficulty is measured as a percent of the number of candidates that scored the item right relative to the total number of candidates that attempted the test (Sambo, 2005). It is a measure of how simple or difficult a test item is. It is calculated using the Frust (1958) formula: -

$$FI = \frac{RU + RL}{N} \times 100$$

Where:

FI = Facility Index;

RU = Number of upper 27% of the students that got the items correct.

RL = Number of the lower 27% of the students that got the items correct.

N = total number of subjects in both the upper and lower 27%. (note: not the total number of students that took the test).

Items with facility indices of between 0.30 – 0.80 are recommended by Frust (1958) and Sambo (2005) for selection as good test items. Thus, for this study the range of 0.30 – 0.80 was used to select items.

3.6.2 Discrimination Index (FI)

The discrimination index of an item refers to the ability of a test item to distinguish between high and low ability students. It is computed by subtracting the number of students in the lower group who score the item correctly from the number in the upper group that also got the item correctly. The difference is divided by half the total number of students in the upper and lower groups. The formula employed is as follows.

$$DI = \frac{RU - RL}{1/2N} \times 100$$

Where:

DI = Discrimination Index;

RU = Number among upper 27% of the students that got the items correct.

RL = Number of the lower 27% of the students that got the items correct.

N = total number of subjects in both the upper and lower 27%. (note: not the total number of students that took the test).

Frust (1958), and Usman (2008) observed that items in a test with facility index between 0.30 – 0.80 are within the range of good test items. They further posited that a discrimination index range of 0.30 – 0.49 are moderately positive items that can be used to accept an item.

Sambo (2005: 280) summarized the above criteria in a simple table marrying the two indices and suggesting when an Item should be accepted, modified or rejected. The criteria are summarized in Table 5.

Table 5: Criteria for Test Items Selection

Difficulty Range (%)	Discrimination range	Decision
40 – 60	0.40 – above	Accept item
40 – 60	0.30 – 0.39	Improvable
Below 40	Below 0.20	Reject
Above 60	Below 0.20	Reject

From the above, items in the draft ISPT were selected, modified or rejected. The corrected version of the ISPT based on the above criteria is at the Appendix E.

3.3.6 Reliability of the instrument

Reliability refers to the degree to which an experiment, test or any procedure yields the same results on repeated trials (Ruland et al., 2007). The reliability of the instrument for this study was obtained by subjecting responses of the pilot study to a statistical analysis using Cronbach‘s alpha technique. Consequently, a Cronbach reliability coefficient of 0.79,0.82,0.92 and 0.77 were obtained for pre – test, post – test, post – post –test and questionnaire items respectively. An instrument is considered reliable if its reliability coefficient lies between 0 and 1. The closer it is to

1, the more reliable the instrument, the closer it is to 0, the less reliable is the instrument. Therefore, the instruments were considered reliable and fit for the study.

3.7 The Students' Attitude to Integrated Science Questionnaire (SAISQ)

The students Attitude to Integrated Science Questionnaire (SABSQ) was developed by the researcher to assess students‘ attitude/perception to Integrated Science. The instrument contained 13 items developed on a five-point Likerts‘ scale of Strongly Agree (SA), Agree (A), Undecided (U), Disagree (D), Strongly Disagree (SD).

3.8 Validity of the Instrument

According to Golafshani (2003), validity describes whether the means of measurement are accurate and measures what they are intended to measure. A test is said to be valid if its results are appropriate and useful for making decisions and judgment about an aspect of students‘ achievement (Gronlund & Linn, 1990). The test items used was validated by two experienced Integrated Science teachers. The items were examined based on the cognitive level of the students and the instructional objectives stipulated in the Integrated Science syllabus for JHS. In this study, face validity of the instruments was assessed by the researcher‘s supervisor and two other senior lecturers. The experts were requested to make recommendations that may enrich and benefit the instrument. Their suggestions were used to improve the validity of the instrument. To ensure content validity of the tests, table of specifications for the lesson plan was used to develop the test items. The suggestions from the lecturers were also used to modify the questionnaire items.

3.9 The Instructional Instruments (Lesson Plan)

The instructional instrument used in this study (lesson plans) were prepared based on the selected topics. There were two instructional instruments: The Ethnoscience

Enriched Instruction Instrument for the experimental group and the Lecture Instrument for the control group.

The instructional instruments were validated by experts in curriculum and instruction from University of Education Winneba. The validation was meant to ensure appropriateness of the stated objective, and the relevance of the instructional materials to the objective of the study.

3.10 Administration of Treatment to the Experimental Group

The administration of the treatment to the experimental group was done by the researcher to ensure the effective utilization of the ethnoscientific processes. This minimized the tendency of the loss of the internal validity of the treatment due to teacher bias. The administration of the treatment took six weeks at two contact hour per week for each school.

The experimental groups were taught using the ethnoscience-enriched instruction. Ethnoscience teaching approach as used in this study involves taking the students out of class to practically undertake or observe some culturally loaded activities like winnowing, floating on calabash, unskinning and dissection of animals, soaking of wilted calabash etc. Specifically, students were made to observe such activities that were termed ―dangerous" or" difficult" like the floating on calabash and the dissection of animals by butchers; while other activities like the winnowing are everyday practices in their homes. Thus, they were made to perform them. The researcher ensured that equal length of time (three weeks 2 hours/week) was used to teach the concepts to the groups. The detail of the lesson plan is presented in appendix A

However, the general steps involved in the instructional process are highlighted in a flow chart as follows.

Figure 1.4 Flow Chart of Ethnoscience-enriched-instruction adapted from Achor, Imoko and Uloko (2009)

Stage 1	**Introduction:** The teacher presents the topic, assesses prior knowledge, organize students to conduct a certain cultural activity and/or go out of class to make observations on a cultural activity e.g. winnowing
Stage 2	**Presentation of the ethno scientific activity to** The teacher makes the students to study the winnowing
Stage 3	Analysis of the ethno scientific activity and relevant principles
Stage 4	Relating the ethnoscientific activity with the teacher relates the phenomena to the concept of
Stage 5	The teacher asks, allow and respond to questions as to why the "light" (less particles) fly away leaving the denser ones.

The control group was taught Integrated Science concepts using lecture Method. The teaching was done for a period of six weeks of 2-hour teaching per week. The teaching was being guided by the validated lesson plans. The students were given lesson notes where necessary. Written assignments were also given to the students after each lesson.

The ethnoscience-enriched-instruction is similar to the lecture method package in terms of content, basic instructional objective and mode of evaluation. The instructional methods only differ in instructional activities.

3.12 Data Collection Procedure

The data for the study was collected through the following steps:

i. The experimental group was taught with the Ethnoscience-enriched-instructional strategy (Appendix A) while the control group was taught using the lecture Method (Appendix B);

ii. The groups were post tested using the same instruments used in the pretest to assess their performance;

iii. The scripts were marked, and the scores were collated;

iv. The experimental groups were further post- post tested two weeks after the first post-test to assess the extent of retention of learnt concepts.

3.13 Procedure for Data Analysis

The data were analysed using relevant statistical tools to answer research questions and test each hypothesis using the Statistical Package for Social Sciences (SPSS) version 16. The research questions were answered using descriptive statistics (Mean, Standard Deviation, Mean Differences, Mean Ranks and Mean Rank Differences). The null hypotheses formulated for testing at $p < 0.05$ were tested as follows:

HO_1:

There is no statistically significant difference between the academic performance of urban and rural Junior High School Integrated Science taught using ethnoscience enriched-instruction and that taught using lecture method.

Statistic: Two Way Analysis of Variance (ANOVA)

HO_2:

There is no statistically significant difference in the retention of Integrated Science concepts between urban and rural Junior High Schools students taught using ethnoscience-enriched instruction and that taught using lecture method.

Statistics: Two Way Analysis of Variance (ANOVA).

The second phase of the analysis was carried out to determine quantitatively students' attitudes towards Integrated Science at JHS level. The quantitative date was analysed using frequency count and percentages.

3.14 Ethical Consideration

The research topic and methodology was approved at a proposal on March 12th, 2021. Letter of introduction were obtained from the Head of Science Education Department, University of Education, Winneba, to the various heads of institutions to facility familiarization, seek their support and smooth gathering of data. Plagiarism was totally avoided as far as this study is concern.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Introduction

This research focuses on examining the impact of |Impact of Ethnoscience – enriched instruction on Attitude, Retention and Performance in junior high school integrated science at Sefwi Wiawso Muncipality. The chapter comprises the analysis of collected data, the presentation of results, and a comprehensive discussion. The results are organized based on the research questions and hypotheses that were formulated to guide the study. The chapter is divided into sub-sections that include the following headings:

- Data Analysis and Results Presentation
- Summary of Major Findings
- Discussion of Results

4.1 Data Analysis and Results

4.1.1 Answering Research Questions

Research Question one*:* What is the difference between the academic performance of urban and rural Junior High Schools Integrated Science students taught using ethnoscience-enriched instruction and those taught using lecture method?

The mean and standard deviation of pre and post-test scores of experimental and control groups are calculated and presented in Tables 4.1 below.

Table 6: Mean and Standard Deviation of Post-test Scores of Urban and Rural Students in Experimental and control Groups

Location	Treatment	No. of students	Mean	Std. Deviation	Mean diff
Urban	Experimental	35	13.20	1.62	7.7400
	Control	38	5.46	2.27	
Rural	Experimental	28	12.40	1.59	7.5900
	Control	30	4.81	1.49	
Urban	Experimental	35	13.20	1.62	0.8000
Rural	Experimental	30	12.40	1.59	

The urban experimental group recorded a mean score of 13.20 and a standard deviation of 1.62 in contrast to the urban control group with a mean score of 5.46. The mean difference between the two groups was 7.74. Correspondently, the rural experimental group recorded a mean score of 12.40 and a standard deviation of 1.59 in contrast to the rural control group with a mean score of 4.81 and a mean difference 7.59. The two comparisons showed that there was relatively marked difference in performance between experimental groups and control groups in favour of the experimental groups that had higher means. However, the comparison of the performance means scores of experimental groups in urban and rural schools revealed a mean difference of 0.80. The difference in the scores between the experimental and control groups is an indication of the influence of ethnoscience-enriched-instruction on academic performance of Integrated Science subject in the experimental groups. Similarly, the performance of experimental group is an indication that the treatment had the influence of enhancing academic performance between urban and rural students.

Research Question 2*: What is the difference in the Retention of Integrated Science concepts between urban and rural Junior High School students taught using ethnoscience-enriched instruction and those taught using lecture method?*

Here, the means of students' post- post test scores in the experimental and control groups of both urban and rural schools were compared and presented in Table 7.

Table 7: Mean and Standard Deviation of Post Post-test Scores of Urban and Rural Students in Experimental and Control Groups

Location	Treatment	No. of students	Mean	Std. Deviation	Mean diff
Urban	Experimental	35	13.48	2.05	6.10
	Control	38	7.38	1.59	
Rural	Experimental	28	12.89	1.41	6.06
	Control	30	6.83	2.32	
Urban	Experimental	35	13.48	2.05	
Rural	Experimental	28	12.89	1.41	0.59

The result in Table 7 revealed that urban experimental schools had a mean performance score of 13.48 while the urban control group had a mean of 7.38. The mean difference was 6.10 in favour of the urban experimental group. Similarly, comparisons of the mean difference between rural experimental and control groups revealed that the rural experimental group had a mean score of 12.89 and that of the control group was 6.83 with a mean difference of 6.06. However, the comparison of the means of both urban and rural experimental groups showed a mean difference of 0.59. The difference in the retention scores between the experimental and control groups is an indication that ethnoscience-enriched-instruction enhanced the Retention of learnt concepts among subjects in the experimental group.

Research Question 3: *What is the students' attitudes towards the study of integrated Science?*

The data obtained from Students Attitude Questionnaire (SAQ) using Likert scale were subjected to analysis, interpretation and computation using frequency counts, percentages and graphs. Respondents attitudes towards ethnoscience enriched instruction are summarized in Table 8.

Table 8: Students Attitudes towards the study of Integrated Science

SN	ITEMS	SA n(%)	A n(%)	N n(%)	D n(%)	SD n(%)
1	I believe science is simple therefore I want to study it.	18(13.7)	20(51.3)	15(11.5)	41(31.3)	37(28.2)
2	I like science subjects because my parents are scientists.	16(12.2)	25(19.1)	18(13.7)	30(22.9)	42(32.1)
3	My parents regularly advise me to study science.	49(37.4)	30(22.9)	10(7.6)	24(18.3)	18(13.7)
4	Science is for the very intelligent students.	40(30.5)	45(34.4)	8(6.1)	20(15.3)	18(13.7)
5	Science is concerned with understanding how the natural world works.	48(36.6)	41(31.3)	15(11.5)	17(12.9)	10(7.6)
6	Scientists can believe in God or a supernatural being and still do good science.	48(36.6)	29(22.1)	20(15.3)	19(14.5)	15(11.5)
7	I will not do science because it changes one‘s faith.	50(38.2)	38(29.0)	15(11.5)	13(9.9)	15(11.5)
8	I see science as the magic of the white man.	15(11.5)	10(7.6)	11(8.4)	53(40.5)	42(32.1)
9	I do not see anything science in what I do every day.	33(25.2)	28(21.4)	29(22.1)	25(19.1)	16(12.2)
10	My teachers do not relate science to my everyday activity.	36(27.5)	43(32.8)	19(14.5)	18(13.7)	15(11.5)
11	I easily understand science because I am interested in it.	20(15.3)	10(7.6)	16(12.2)	45(34.4)	40(30.5)
12	I lose interest whenever it is time for science lesson.	44(33.6)	47(35.9)	10(7.6)	18(13.7)	12(9.2)
13	My major problem with science is the calculations it contains.	39(29.8)	34(26.0)	13(9.9)	27(20.6)	18(13.3)

The first item is ―I believe science is simple therefore I want to study it.” With this, 37 students 28.2%, 41 students representing 31.3% and 15 students representing 11.5% chose strongly disagree, disagree and neutral respectively while 20 students and 18 students, representing 15.3% and 13.7% respectively disagreed and strongly disagreed respectively. The above percentages are a clear indication that students have negative attitudes towards the study of Integrated Science.

On item 2, 16 students representing 12.2%, 25 students representing 19.1% represent 13.7% chose strongly agree, agree and respectively and as many as 30 students representing 22.9% and 42 students representing 32.1% didn‘t support the fact that ―they like Integrated Science subject because their parents are scientists”. Only 18 students representing 13.7% neither agreed or disagreed. This indicates that more than half of the students believe that they like science subject not because their parents are scientists.

Item 3 was worded as ―My parents regularly advise me to study science” with this, 49 students representing 37.4%, 30 students representing 22.9% supported the notion while 24 students representing 18.3% and 18 students representing 13.7 disagreed and as low as 10 students represent 7.6% were neutral about the notion. More than half of the sample supporting the notion is a clear indication that parents advise has influence in their wards interest in the study of science.

On item 4, 64.9% gave positive response (SA and A) whiles 29.0% responded negatively (15.3%SD and 13.7%D). This indicates that, majority of the students believe that ―Science is for the very intelligent students”.

On item 5, 36.6% and 31.3% of the students chose strongly agree and agree while 12.9% and7.6% chose disagree and strongly disagree respectively indicating that most of the students were ―concerned with the fact that, science understands how the natural world works" while 15 students representing 11.5% were neutral about the notion or the item.

Item 6 was worded as ―Scientists can believe in God or a supernatural being and still do good science". With these 48 students representing 36.6%, 29 students representing 22.1% and 20 students representing 15.3% chose strongly agree, agree and neutral respectively while 19 students representing 14.5% and 15 students representing 11.5% respectively disagreed and strongly disagreed indicating the students believe that scientist can believe in God and still do good science.

Item 7 was negatively worded as ―I will not do science because it changes one's faith". With these 50 students representing 38.2%, 38 students representing 29.0% and 15 students representing 11.5% chose strongly agree, agree and neutral respectively while as least as 13 students representing 9.9% and 15 students representing 11.5% chose disagreed and strongly disagreed respectively. This is a strong indication that students have a positive attitude to the notion.

On item 8, 19.1% gave a positive response (SA and A) whiles 72.6% responded negatively (40.5%D and 32.1%SD). This indicates that, majority of the students do not believe that science is magic of the white man.

On item 9, 33 of the students representing 25.2%, 28 students representing 21.4% and 29 students representing 22.1% chose strongly agreed, agreed and neutral respectively while 25 students representing 19.1% and 16 students representing 12.2% disagreed and strongly disagreed respectively. Comparatively, majority of the students support the notion that ―they don't see anything science in what they do every day.

On item 10, 60.3% of the students gave a positive response (SA and A) while 25.2% responded negatively (13.7% D and 11.5% SD). This is indication that, majority of the students believe the notion that ―their teachers do not relate science to my everyday activity".

On item 11, 15.3% and 7.6% of the students chose strongly agree and agree while 34.4% while 30.5% chose disagree and strongly disagree respectively indicating most of the students responded negatively to the item ―understand science because they are interested in it".

On whether students' loose interest whenever is time for science, 35.9% and 33.6% responded strongly agree and agree respectively while 13.7% and 9.2% responded disagree and strongly disagree respectively indicating that most of the students have low interest in Integrated Science.

On whether students have problem with calculations in science, 55.8% of strongly agree and agree (29.8% SA and 26.0% A). 13.3% and 20.6% responded disagree and strongly disagree respectively indicating that students have problem with science calculations.

4.1.2 Hypothesis Testing

The null hypothesis 1 sought to find out if there was any significant difference in the academic performance of students taught to Integrated Science concepts using ethnoscience-enriched-instruction and those taught using lecture methods. The null hypothesis is restated hereunder:

Ho_1

There is no significant difference between the academic performance of urban and rural Junior High School Integrated Science taught using ethnoscience enriched-instruction and that taught using lecture method.

To test the hypothesis, the post-test performance scores of the experimental and control groups were subjected to Two Way Analysis of Variance. The result is shown in Table 9

Table 9: Two Way Analysis Variance for Post-test Scores of Subjects in the Experimental and Control Groups.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	3800.69	3	1266.90	98.14	0.001
Intercept	36862.36	1	36862.36	2.86E3	0.001
Location	18.82	1	18.82	11.46	0.023
Treatment	3713.20	1	3713.20	287.63	0.001
location treatment	0.13	1	0.13	0.01	0.919
Error	2698.11	209	12.91		
Total	**42913.00**	**213**			
Corrected Total	6498.80	212			

Significant at $p \leq 0.05$

From Table 10, the calculated F (1, 209) = 287.63; $p < 0.05$ revealed that there is significant difference in the academic performance of students in the experimental and control groups. Thus, the null hypothesis is rejected. To establish the point of difference, the data was further subjected to multiple comparison. The summary of the comparison is in Table 10.

Table 10: Multiple Comparisons of the Post-test Performance Scores of Students in Experimental and Control Groups of Urban and Rural Schools.

(J) groups1	Mean Difference (I-J)	Std. Error	Sig.
Control Urban	8.36	0.67	0.001
Experimental Rural	0.55	0.72	0.911
Control Rural	9.00	0.68	0.001
Experimental Urban	-7.83	0.72	0.001

Result of the multiple comparisons showed a significant difference between the schools in experimental groups and control groups at different p values in favour of the experimental group. Thus, the null hypothesis one was rejected. That is, there is significant difference in the academic performance of students taught with ethnoscience-enriched-instruction and those taught using the traditional (lecture) method where teaching is restricted to the ―talk and chalk" approach. This showed that the experimental groups had performed better than the control groups. It also confirms that ethnoscience-enriched-instruction is a viable approach to enhancing students' academic performance.

Ho$_2$: *There is no significant difference in the Retention of Integrated Science concepts between urban and rural Junior High Schools students taught using ethnoscience-enriched instruction and that taught using lecture method*

To test the hypothesis, the post-post-test scores of the students in the experimental and control groups were subjected to Two Way ANOVA. The results are summarized in Table 11.

Table 11: Two Way Analysis of Variance

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	2310.67s	3	770.22	59.13	0.001
Intercept	34506.16	1	34506.16	2.649E3	0.001
Location	136.94	1	136.94	10.51	0.001
Treatment	2095.32	1	2095.32	160.85	0.001
location treatment	2.71	1	2.71	.21	0.649
Error	2709.47	208	13.03		
Total	**39356.00**	**212**			
Corrected Total	**5020.13**	**211**			

Results of the comparison of post-post-test scores of students in the experimental and control groups from urban and rural schools as revealed in Table 12, the calculated F (1, 208) = 10.512; $p < 0.05$ reveal that there is significant difference in the retention of learnt concept among schools in the experimental and control groups. Hence, the null hypothesis is rejected. To find the point of difference, the scores were further subjected to multiple comparison. The summary of the analysis is presented in Table 12.

Table 12: Scheffe's Multiple Comparisons of the Post-Post-test Performance Scores of Students in Experimental and Control Groups of Urban and Rural Schools

(I) groups	**(J) groups**	**Mean Difference (I-J)**	**Std.]**	**Sig.**	**95% Confidence Interval Lower Bound**	**Upper Bound**
Experimental Urban	Control Urban	6.05*	0.68	0.001	4.15	7.96
	Experimental Rural	1.34	0.72	0.326	-0.68	3.37
	Control Rural	8.09*	0.69	0.001	6.16	10.02
Control Urban	Experimental Rural	-4.71*	0.72	0.001	-6.74	-2.69
	Control Rural	2.04*	0.69	0.034	0.11	3.97
Experimental Rural	Control Rural	6.75*	0.73	0.001	4.70	8.80

Sig. at P < 0.05

From Table 12, multiple comparison showed a no significant difference in the retention mean scores of the experimental groups in both urban and rural schools (p = 0.326) and also showed that there was significant difference between the experimental and control groups (p = 0.001).

The hypothesis also examined if any difference exists in the retention abilities of urban and rural students exposed to ethnoscience-enriched-instruction. Results of the comparison of post-post-test scores of students in the experimental groups from urban and rural schools as revealed in Table 13, shows that the p value is greater than the 0.05 level of significance. This reveals that there is no significant difference in the retention of learnt concept among schools in the urban and rural locations. Hence, the null hypothesis is retained. However, the results showed a significant influence in interaction between the methods of instruction and location of students (F (1, 208) =

0.208, p > 0.05). This shows that ethnoscience-enriched-instruction significantly influence learning among urban and rural schools.

4.2 Summary of Findings

From the results presented in this study, the summary of the major findings is:

Students taught Integrated Science concepts using the ethnoscience-enriched instruction performed better than those taught same concepts using lecture method;

Urban and rural school students taught Integrated Science concepts using ethnoscience-enriched-instruction had significantly better retention of learnt concepts than their counter parts taught same concepts using lecture method;

Students exposed to ethnoscience-enriched-instruction developed more positive attitude to Integrated Science than those exposed to lecture method of teaching.

4.3 Discussion of Results

This section focuses on the discussion of the results, organized according to the order of the research hypotheses:

The results from the testing of null hypothesis one showed that the subjects in the experimental groups taught Basic Science concepts using the ethnoscience enriched-instruction performed significantly better than their counterparts in the control group who were taught same concepts using lecture method. This suggests the effectiveness of the ethnoscience-enriched-instruction at enhancing learners‟ academic performance over lecture method.

This could be because the ethnoscience-enriched-instruction involved practices which the learners are familiar with. The introduction of such activities in classroom interaction generated a novel situation that influenced the students ‟inquisitiveness towards learning. Similarly, the students‟ familiarity with the practices provided them with the required link to which they anchored their learning. Thus, the practices acted as „prior knowledge" which Ausubel (1968) stressed, was necessary for meaningful learning.

The finding of this study is supported by those of Achor, Imoko, & Uloko (2009) who studied the effects of Ethnomathematics Teaching Approach (ETA) on senior secondary students" performance and retention in locus. Their findings revealed that students taught Locus using ETA had higher academic performance than those taught using the conventional approach. They argued that the higher performance by the ETA taught group was because the group was able to integrate or link their background/indigenous knowledge to the new concepts they were taught.

The relatively poor performance of students in the control group is a vivid indication of the ineffectiveness of lecture method of teaching, despite the fact that it has been the most adopted among teachers. The poor performance attributed to lecture method was because it only appeals to the learner‘s auditory sense (Paris, 2014).

Thus, learners who are week in cognition especially children at the basic level, that are classified to be at ―concrete operation stage" learn by doing (activity) rather than by mere listening will not benefit maximally from lecture instruction. Such students when taught with lecture method learn little or will not acquire the desired skills; hence, they would resort to rote learning. The ethnoscience-enriched-instruction on the other hand, involved taking the students out of class to make observations as well as involves the use of practices the learners never expected to be scientifically relevant. The use of such practices had influenced the inquisitiveness of the learners and had motivated them to learn.

This position is supported by Okoli (2006), Owolabi, (2006) Okeye & Okeke (2007), Akinbobola and Folasade (2009), who argued that meaningful learning that yields good academic performance takes place only when teaching is structured alongside instructional strategies that promotes active participation of students in the learning process. In this case, the students‛ active participation is not provided for by lecture method but by the ethnoscience-enriched-instruction.

The results of the finding of this study have, in respect of students‛ performance in urban and rural experimental groups showed that there was no significant difference in their academic performances. This showed that ethnoscience enriched-instruction had improved the performance of both the students in rural and urban schools.

The improvement in performance of rural students as observed in this study was attributed to the nature of the ethnoscience-enriched-instruction which incorporates culturally relevant practices the students are familiar with in the teaching of science. This finding was supported by Alokan and Arijesuyo (2013) who reported no significant difference in the academic performance of students from urban and rural schools. They concluded that the difference often observed by researchers in students‛ academic performance cannot be attributes to their environment, but to the nature of instructions (teaching approach) the students were exposed to.

The finding of this study however, contradicted those of (Habib, 2003; Uju, 2006; Ferguson, 2009) who established in their different studies on effect of instructional strategies on rural and urban students‛ performance that academic performance varies with location. Most of the conclusion has been in favour of urban schools. It was also contrary to the findings of Michigan (2013) who confirmed that the difference in performance between urban and rural schools was due to the availability of technology in the urban areas. Thus, if this reason was the cause of the difference between urban and rural schools, ethnoscience-enriched-instruction, in this study, has been able to bridge the gap created by the lack of technology and provided the rural students with the boost to catch up with their urban counterparts. The essence of learning is to bring about a long-lasting change in the learner.

Thus, if a learner learns and forgets easily, such learning may not be worthwhile.

Null hypothesis two sought to find out if any significant difference exists in the retention of Integrated Science concepts among students in the experimental and control groups. The results showed that a significant difference exist in favour of the experimental groups exposed to the ethnoscience-enriched-instruction. This showed that the use of ethnoscience-enriched-instruction enhanced students‘ retention of learnt concepts. This is because the ethnoscience-enriched-instruction involved the practices and activities that were very familiar and often carried out by the learners. Thus, the learners‘ familiarity provided some grounds upon which their new experiences were anchored; Thus, providing them with long lasting experiences. This finding is in agreement with that of Olorukooba and Lawal (2010) who established that Specialist Teaching Service (STS) is a teaching approach that provides a linkage or connection between science concepts and the context of human experience which Ethnoscience-enriched-instruction is an aspect of.

Research question three was to found out students‘ interest towards the learning of Integrated Science. Researchers have established that students have negative attitudes towards science and science related disciplines (Abonyi, 2002; Sola & Ojo, 2007). This was because certain science concepts were perceived to be difficult by students; this affects their academic performance (Akinbobola and Ikitde, 2008).

However, the results of this study revealed that there is a significant difference in the attitude to Integrated Science among students exposed to ethnoscience-enriched instruction and those exposed to lecture method. This showed that the ethnoscience enriched-instruction have the potentials of instilling positive attitudes to science learning among students. The observed impact of ethnoscience-enriched-instruction could be related to the students‘ familiarity with the practices and materials they were taught with. The introduction of the ethnoscientific processes has also improved the interpersonal relations between the subjects because; they were seen consulting one another during the demonstration/presentation of the ethnoscientific process. This result agrees with the findings of Abonyi (2002) who asserted that ethnoscience enriched-instruction have significantly improved students‘ interest towards science. It also agreed with the positions of Cracker (2006) and Akinbobola & Ikitde (2008) who established that a person‘s attitudes are learned; as opposed to being inherited Thus, it can be changed through persuasion using a variety of techniques.

The finding is also supported by Nwosu (2003) who posited that innovative instructional processes like constructivism can significantly improve favourable attitudes towards the learners.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0 Overview

This research aimed to investigate the impact of Ethnoscience – Enriched Instruction on Attitude, Retention and Performance in Integrated Science among Junior High Schools in Sefwi Wiawso Municipality. This chapter provides a comprehensive overview of the research findings, draws conclusions based on the results, discusses the contributions to the knowledge of the study, and presents recommendations for future research. The chapter is structured into the following sections, summarizing the key aspects of the study's outcomes:

5.1 Summary

This study investigated the effect of ethnoscience-enriched-instruction on attitude, retention and academic performance in Integrated Science among Urban and Rural student s in Sefwi Wiawso Municipality.

The sample comprised of 131 JHS 2 students from four Junior High Schools in Sefwi Wiawso Municipality. The sample was selected through simple random draw from hat method.

Two instruments were used to collect data for the study. The 25 (Multiple choice) item Integrated Science Performance Test (ISPT) and the 20 item Students' Attitude to Basic Science Questionnaire (SABSQ). The instruments were self-developed by the researcher, validated and found to be reliable with coefficients of $r= 0.658; p<0.05$ and $r = 0.617; p>0.05$ for ISPT and SAISQ respectively.

The schools were pretested with both instruments to ensure that they were of equal ability in academic performance and disposition to science. The schools were randomly assigned into experimental and control groups. The experimental groups were taught Integrated Science concepts using ethnoscience enriched-instruction while the control groups were taught same concepts using lecture method. The treatment was conducted in six weeks.

After the six weeks teaching, the students were administered with both the ISPT and SAISQ as post-tests. The ISPT was further re-administered some two weeks after the post-test (post-post-test). The results obtained were subjected to relevant statistics using the SPSS version 20 software at $p < 0.05$. The ISPT scores were subjected to Two Way Analysis of Variance and Independent Sample t-test; while the means of each item on the SABSQ data were used to analyzed the results. The summary of findings and discussion of the results were presented.

5.2 Summary of Findings

Students who received instruction using the Ethnoscience instructional approach demonstrated superior academic performance compared to students in the control group (Lecture method).

Urban and rural school students taught Integrated science concepts using ethnoscience-enriched-instruction had significantly better retention of learnt concepts than their counter parts taught same concepts using lecture method;

Students exposed to ethnoscience-enriched-instruction developed more positive attitude to Integrated Science than those exposed to lecture method of teaching.

5.3 Conclusion

Based on the results obtained from this research, the following conclusions can be drawn:

1 Students who were taught using Ethnoscience – enriched instruction exhibited superior academic performance compared to the students who were taught using Lecture method

2 Students who were exposed to the Ethnoscience – enriched instruction showed high Retention rate compared to their fellow counterpart in the control group.

3 Students exposed to ethnoscience-enriched-instruction developed more positive attitude to Integrated Science than those exposed to lecture method of teaching.

5.4 Recommendations

On the basis of the findings and conclusion reached in this study, the following recommendations are made:

1 Junior High School (JHS) instructors should consider implementing the Enthoscience – enriched approach in their teaching of Integrated Science, as it is effective in enhancing academic performance.

2 Both the Ghanaian government and state ministries of education should actively promote and monitor the implementation of Enthoscience – enriched instruction in Junior High schools, since is effective way of ensuring retention among students.

3 Teachers should use good innovative methods that will stimulate students' interest in an attempt to make learning of science more meaningful to the learners and thereby generating improved learning outcomes that will lead to a change in attitude towards science.

4 Science curriculum should be reviewed in terms of basic instructional approaches to incorporate some basic ethnoscientific or culturally relevant materials and practices in a systematic and well-articulated approach to facilitate learners to gain confidence and appreciate the emerging modern scientific concepts.

5.5 Suggestions for Further Studies

The study may be expanded in the following ways:

1 The identified ethnoscientific concepts can be used to conduct similar researches in specialized science subjects like Chemistry, Physics, Biology, and Mathematics;

2 Studies should be conducted to explore more ethnoscientific processes other than the ones identified and used in this study with the view to increase the number in the catalogue of such practices;

3 There is need to assess the efficacy of the ethnoscience-enriched-instruction relative to other instructional strategies like the process approach, demonstration method etc.

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APPENDICES

APPENDIX A

Lesson plan for experimental group (Ethnoscience-enriched-instruction instruction)

Name of Researcher: **Anane Simon**

Subject: Integrated Science

Topic: Acids

Level of Group: J.H.S. 2

Average age of Students: 14

Entry behaviour:

The students are used to feeding/eating from materials that have sour taste.

Instructional Materials: unripe orange, lemon, tamarind, litmus paper, beakers/cups, sample of inorganic acid, water

Behavioural Objectives:

at the end of the lesson, students should be able to: -

i. define acids;
ii. Identify the properties of acids
iii. Identify an acidic solution
iv. Mention some examples and sources of acids
v. Mention uses of acids
vi. Arrange an acid/base titration
vii. Produce salt from acid/base reactions

Activity 1.

Step 1: Introduction.

a) The teacher introduces the lesson by narrating a simple story of a fight between two people. When the two people were separated, one of them picked a bottle containing some liquid and poured the liquid on the face of his co - fighter. Immediately, the man‘s face got ―burnt”. (the teacher and students further discuss the incidence and its implications).

The teacher also highlights the scenario in which the student's mothers' cooks stew, the stews tastes sour but they add potash to it. To harness the students understanding, the teacher raises the following questions.

i. What is the taste of the stew their mothers cook?
ii. What is the cause of the sour taste?
iii. What other substances tastes sour?

Step 2: Presentation

The teacher presents the following items to the students

i. unripe orange
ii. lemon
iii. Tamarin
iv. litmus paper sample of inorganic acid
v. water

Step 3:

- the teacher asks students to squeeze the juices from the fruits provided and soak the tamarind in a cup of water;
- the teacher asks the pupils to taste the juice and record their observation; the teacher ask the pupils to dip blue and red litmus papers into the juices as well as the sample of inorganic acid and record their findings;
- the teacher asked the pupils to pour the organic and inorganic acids on a piece of paper or cloth and make observation;
- the teacher repeats the questions posed at the introduction

Activity 2:

The teacher presents analogical story of a woman that cooks stew. The woman, at a time may taste the soup, the teacher asks the students what observations is the woman likely to make?

(The observations will include the sweetness, sourness, etc) The teacher will then make students to make comparison between The staste of the soup and that of the acids in activity 1.

Teacher and students will identify and name some common organic and inorganic acids

Conclusion:

The teacher concludes by giving the students the following notes

An acid is a substance which produces hydrogen ion (proton) as the only positive ion when dissolved in water.

Properties of acids:

i. acids have sour taste;
ii. acids are corrosive;
iii. acids change blue litmus paper red,
iv. acids neutralize base

Examples Of Acids

Sn	Organic Acids		Inorganic Acids	
	Names	Source	Names	Source
1	Ethanoic Acid	Vinegar	Tetraoxosulphate VI acid	HNO_3
2	Lactic Acid	Milk	Trioxonitrate IV acid	HNO_3
3	Citric Acid	Lemon	Hydrochloric acid	HCl
4	Amino Acids	Proteins		
5	Fatty Acids	Fats & Oil		

Uses of Acids

i. as foods
ii. HCl for removal of rust
iii. production of soap
iv. HCl as electrolyte
v. HNO_3 for production of accumulators‘ fertilizers

Name of Researcher: Anane Simon

Subject: Integrated Science

Topic: Bases

Level of Group: J.H.S. 2

Average age of Students: 14

Entry behaviour:

The students are used to feeding/eating from materials that have bitter taste; they are used to seeing their mothers add potash into sour soups, etc.

T.L.Ms: Ash, Potash (black and red), sample of standard base (Potassium/Sodium hydroxide), water

Behavioural Objectives:

at the end of the lesson, a student should be able to:

i. define bases
ii. Mention/list the properties of bases
iii. Classify strong and weak bases
iv. Mention some examples and sources of bases
v. Mention uses of bases
vi. Produce salt from acid/base reactions

Step 1: Introduction.

The teacher introduces the lesson by reviewing the process of cooking stew in which potash is usually added. He observes that when the potash was not added, the soup was sour, but when the potash was added, the sour taste disappeared. This shows that the potash and the sour taste have negative effects. The teacher Thus, asks: Why does the woman add potash to sour soups?

Step 2: Presentation

The teacher presents the following items to the students

i. Ash,
ii. Potash,
iii. red potash,
iv. litmus paper,

v. sample of standard base (Potassium/Sodium hydroxide),

vi. water.

Step 3:

- the teacher asks students to dissolve the ash, potash, red potash in different containers;
- the teacher asks the pupils to taste the all the solutions (except those of the standard base) and record their observation;
- the teacher asks the pupils to dip blue and red litmus papers into all the
- solutions and record their findings;
- the teacher asks the students if there was anything they observe from what they did so far;
- the teacher repeats the questions posed at the introduction

Step 4:

The teacher explains the properties of bases from the students" observations as having:

bitter taste;

- change red litmus paper blue,
- corrosive tendencies;
- soapy feel to touch;
- ability to neutralize acids

Conclusion:

The teacher concludes by giving the students the following notes

A base (alkali) is a substance which can combine with hydrogen ion when dissolved in water.

Properties of bases:

- bases have bitter taste
- bases change red litmus paper blue,
- concentrated forms bases are corrosive
- they are soapy to touch

- Bases neutralize acids

Examples and uses of bases

Locally bases are used in the cooking of food (e.g. in cooking of beans, in neutralizing the sour taste of stew) and in emulsification of pounded guinea corn (Tuwon Dawa).

Bases are also used locally to manage stomach offsets.

Standard bases are however used in the followings

Sn	Names	Formula	Uses
1	Sodium Hydroxide	NaOH	Manufacture of soap, plastics and petrol refining.
2	Potassium Hydroxide	KOH	Manufacture of liquid soap, dying and electroplating
3	Calcium Hydroxide	$Ca(OH)_2$	For production of cement and tooth paste
4	Magnesium Hydroxide	MgOH	As laxative

Evaluation

The lesson will be evaluated by making students to answer the following questions.

1. Why do their mothers add potash to sour soups?
2. What are bases?
3. State three (3) properties of bases
4. What are the examples of bases that are often used in our homes?
5. State three (3) uses of bases

Lesson plan for experimental group (Ethnoscience-based instruction)

Name of Researcher: Anane Simon

Subject: Integrated Science

Topic: Force

Level of Group: J.H.S. 2

Average age of Students: 14

Entry Behaviour:

The students are used to pushing and pulling objects to make them move, playing with strings to produce a rotation on a tied circular body, removing/separating maize grain from its cob.

T.L. Ms.:

catapult, fixed doors, strings, metal bottle tops or tin covers, pictures of women carrying loads freely on the head, donkeys carrying goods, maize cobs, palm oil.

Behavioural Objectives:

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

i. Explain the concept of force;
ii. Apply force to operate a machine;
iii. Solve arithmetical problems involving forces
iv. Demonstrate balanced and unbalanced forces
v. State the principle of moment;
vi. Solve the simple problems involving the equilibrium of forces;
vii. Explain friction.

Step 1: Introduction.

a) The teacher introduces the lesson by presenting the following situations to students.

i. A man pulling a goat to the market
ii. A woman carrying a calabash or any container freely on her head without holding
iii. A man carrying twin cans of water on his shoulder
iv. A donkey carrying log of woods or manure to the farm

b) The teacher raises the following questions to the students:

i. Why is the man pulling the goat?
ii. Why is the calabash not falling of the woman‘s head?
iii. What happens if there is difference in the quantity of water in either of the cans?
iv. What happens if either of the donkey‘s side loads out weight the other?

c) The teacher further raises the following questions to guide the teaching having made students to appreciate pulling as a type of force.

i. What are forces?
ii. What types of forces?
iii. What are the effects of forces on objects?
iv. What is the effect of balanced and unbalanced forces on objects?

Activity 1:

i. definition of force

Step 1: Presentation

i. The teacher asks a student to push or pull the door and let it swing on its hinges,
ii. The teacher guides the students to, flatten the metal bottle top and make two holes at their Centre; the students will insert the string through the holes a tie the ends.
iii. The students will be made to swing the string with the top at the Centre after which they will pull the string to make the bottle to accelerate in a rotation order.
iv. From the above motion, the teacher and the student derive the mathematical definition of force, establish that forces changes the state of motion of bodies as well as establish that the masses of bodies determine the acceleration induced by the force.

Activity 2: balanced and unbalanced forces

i. The teacher asks a student to carry a calabash, bowl, or any object on his/her head freely without holding.
ii. The teacher asks the students why the load was not falling of the head.
iii. The teacher introduced the „*Jakin Birni*‟ Game to the students. The game is a

Sefwi traditional game played by children. It involves the horizontal mounting of a stick with uniform cross section over another vertically fixed stick. A finger is used to turn the horizontal stick in either clockwise or anti clockwise direction. If the horizontal stick is pivoted at the right point, (center of gravity of the horizontal stick) it will continue to rotate without falling. But if it is pivoted, at any point other than the Centre of the stick, it will fall.

iv. The teacher asks the students why the stick will fall or will not fall during the process.

iv. The teacher presents pictures of farmers carrying corn stalks and manure to the farm on donkeys.

v. The teacher makes the students to analyse if the mass of either of the sides should be increased or the stalks be placed with one side longer than the other what will happen.

vi. The teacher balances the metre rule on the knife edge;

vii. Hangs a known weight on one end of the balanced metre rule and asks students what they observe;

viii. The teacher adds a known weight to the other end of the rule.

ix. He/she asks the students if the metre rule regained its balance.

x. What type of machine makes use of this principle?

Conclusion

The teacher concludes the lesson by giving the students the following notes.

Forces: is either a push or a pull. It is that which changes or tend to change the state of motion of a body. Usually, when an object is at rest, (not moving) the sum of the forces making it to move and that which is stopping from moving is equal to zero. Thus, for an object to move, an additional force that will overcome the force making it not to move is needed. Thus, the more the force, the more the movement.

Force is mathematically defined as

$F \alpha a$

Where F = force a = acceleration

Thus, inserting a constant to make the proportionality a constant, the basic factor that determines the effects of force on acceleration of a body is the mass of the body. Therefore, we've

$F = ma$

The unit of force is the Newton (N)

Effects of force on bodies

i. It causes motion, retard or stop motion;
ii. It leads to the deformation of the shape of objects;
iii. It causes the breakage of objects

Example.

A body of mass a body of mass 5kg is acted upon by a force that makes it moves at $5m/s^2$ if the body moves through a distance of 10m in 2 seconds, calculate the magnitude of the force that acted on the body

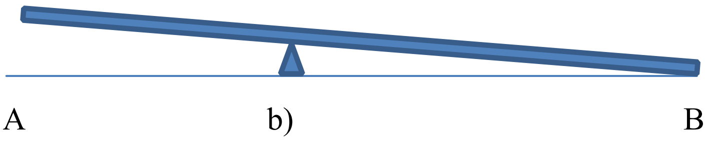
The magnitude of the force (F)that acted on the body
F = Mass x Acceleration $F = M \times a$ $F = 5kg \times 5m/s^2$ $F = 25\ kgm/s^2$ F = 25N

Balanced forces

The teacher asks one of the students to carry a log of wood freely on his/ her head. The teacher asks the students to explain the bases of the stability of the wood. The students should also try placing the wood at different positions. The teacher identifies the name of the head in the set up (fulcrum/knife edge). And make students appreciate that whenever a mass is added to either sides of the wood, the balance will be distorted. Thus, there are equal quantity of forces acting on either sides of the wood of which tempering with them could affect the balance (equilibrium) of the body. These forces are called parallel forces.

Parallel forces are two or more forces that act in the same direction with one another. They can act vertically downwards, upwards or horizontally. In the log of wood example given above, the forces acting on either side of the head are equal when the wood stabilizes on the head. As shown below.

a)



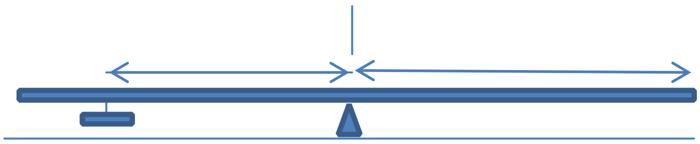
b)

a) a body balanced on a fulcrum; equal forces acts on either sides of the body.

b) a body unbalanced on a fulcrum; more forces act on side B than A of the body

the unbalance in the forces acting on a body makes the body to move about a given point (fulcrum) this movement is called the turning effect of forces or principle of moment.

The moment of a force about a point is defined as the product of force and the perpendicular distance from the point of the line of action. From the above therefore, the principle of moment states that *when a body is in equilibrium under the action of several forces, the sum of clockwise moments about any point is equal to the sum of anticlockwise moment.*



Thus, the position at which a given mass would be hung to make the body balanced can be calculated by the formula:

Clockwise moment = W_1 x OA

Anticlockwise moment = W_2 x OB

Thus, $\mathbf{W_1}$ **x OA =** $\mathbf{W_2}$ **x OA**

Example 1:

a stone of mass 30g was hung at one end of a wooden metre rule at 30cm mark from one edge. At what point on the other side will a mass of 25g be hung to keep the rule at equilibrium?

Example 2:

a bar pivoted at O, has forces 30g and 20g acting at 30cm and 10cm respectively from one side of O. find the point on the other side at which a 50g force will need to act in order to keep the bar at equilibrium.

Evaluation

The lesson will be evaluated by making students to answer the following questions

1. What are forces?
2. What types of forces?
3. What are the effects of forces on objects?
4. What is the effect of balanced and unbalanced forces on objects?

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Lesson plan for experimental group (Ethnoscience-enriched-instruction)

Name of Researcher: Anane Simon

Subject: Integrated Science

Topic: Density

Level of Group: J.H.S. 2

Average age of Students: 14

Entry Behaviour:

The students are used seeing their parents separate rice from stones; winnowing to separate grains from chaff, they are used to seeing ships, boats/canoes floating on water with all their loads.

Instructional Materials:

scenes of a woman separating grains from chaff through winnowing, separating rice from stones, pictures/scene of fishermen floating on calabash.

Behavioural Objectives:

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

i. Explain the density;

ii. Compute the magnitude of the densities of bodies;

iii. iii. Identify the applications of density

Step 1: Introduction.

i. Teacher takes students out of the class to observe the practice of winnowing;

ii. The teacher asks students the various methods used by their mothers in the separation of grains from chaff.

iii. The students will also be asked to discuss how parents remove stones from local rice before cooking.

iv. The teachers ask the students the scientific bases for the travel of the chaff away from the position (mass & volume relationship)

v. The teacher presents the picture of fisherman floating on calabash and asks students if there is any relationship between his floating and the „flying away" of chaff during winnowing;

vi. The teacher defines drops a piece of stone in water and a piece of corn pod (bigger than the stone in water) and allow students to make observation of which of the two will sink or float.

vii. The teacher defines density as the ratio of the measure of mass of a body to that of its volume.

Mathematically: density =mass/volume

The teacher then asks the students if they see anything science in such practices. The teacher defines density and practically demonstrate that a volume of chaff less mass compared to an equal volume;

The teacher shows that the difference in densities of the chaff and the grain is responsible for the ease in the separation.

Step 2: computation of densities

Density = mass/volume

Example: a body of volume $5cm^3$ has a mass of 2g. calculate the density of the body.

Density = 2/5

= $0.4\ g/cm^3$

Evaluation

The lesson will be evaluated by making students to answer some questions based on the followings:

1. Explain the density;
2. Compute the magnitude of the densities of bodies;
3. Identify the applications of density

Lesson plan for experimental group (Ethnoscience-based instruction)

Name of Researcher: Anane Simon

Subject: Integrated Science

Topic: Digestive System

Level of Group: J.H.S. 2

Average age of Students: 14

Entry Behaviour:

The students are used to feeding and can identify the benefits of eating. The students are also aware that the foods they eat undergo some changes after they ate, and it is evident in their stool.

Instructional Materials: scene of a butcher dissecting a goat or a sheep, charts showing labeled alimentary canal of man and/or rabbit.

Behavioural Objectives:

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

i. Identify parts of alimentary canal;
ii. Describe the roles of the different parts play in digestion;
iii. Describe digestion and absorption processes;
iv. Draw the parts of the alimentary;
v. Explain the end product of digestion of food.

Step 1: Introduction.

i. The students are taken to the scene of butchers' dissection
ii. The students are directed to observe and list the internal parts of the alimentary canal, note their local and scientific names;
iii. The students should identify the function of each part in the guidance of the teacher.

Conclusion

Digestion is the process by which food is broken down into simple, soluble substances by mechanical and chemical means for the body to absorb and use. This process occurs in the alimentary canal in human and other high animals.

The alimentary canal

The alimentary canal is a long tube that starts from the mouth and ends at the anus. It is made up of different organs and most of it is coiled up in the abdominal cavity. The components of the alimentary canal are summarized in the diagram below:

Roles of the parts of the alimentary canal

Part of Alimentary Canal	**Function**	
Mouth	1. The process of digestion starts from the mouth. As food gets into the mouth, it is broken down/grinded mechanically by the teeth. 2. Grinded food mixes with saliva which contains an enzyme (ptyalin) that is responsible for the convert starch to soluble sugar	
Oesophagus	3. The function of oesophagus is to push food from the mouth to the stomach through peristalsis.	
Stomach	4. The main function of the stomach is to mix food with water to produce a smooth pulp called chime through mechanical movement of the walls of the stomach 5. The walls of the stomach secretes gastric juice which helps to convert part of protein into soluble form	
Small Intestine	Food digestion is completed here by the secretion of the following juices. 6. Pancreatic juice: contains:	
	i.	Amylopsin - carbohydrate
	ii.	Trypsin - protein
	iii.	Lipase – fats
	2.	Digested foods are absorbed into the blood by the wall of the small intestine.
Large intestine	This is not a digestive organ, it is main function is the reabsorption of water and passing out of the undigested food through the anus	

Evaluation

The lesson will be evaluated by making students to answer the following questions

1. Identify parts of alimentary canal;
2. Describe the roles of the different parts play in digestion;
3. Describe digestion and absorption processes;
4. Draw the parts of the alimentary;
5. Explain the end product of digestion of food.

Lesson plan for experimental group (Ethnoscience-based instruction)

Name of Researcher: Anane Simon

Subject: Integrated Science

Topic: Osmosis

Level of Group: J.H.S. 2

Average age of Students: 14

Entry Behaviour:

Students have seen liquids moving from one place another before

Instructional Materials:

scene of calabash reformation after its wilting. Wilted calabash, Irish potato/yam, knife, water, common salt.

Behavioural Objectives:

at the end of the lesson, the student should be able to:

i. Explain the concept of osmosis;
ii. Demonstrate the process of osmosis
iii. Explain the bases of the basis of the movement of water molecules
iv. Explain their importance in everyday life;

Step 1: Introduction.

i. The teacher introduces the lesson by showing the students the wilted calabash and asking them what was the cause of the wilting, and if there is anything that could be done to make it back to its useful shape. The teacher asks for the traditional name for the practice.

ii. The teacher takes the students to the riverside to witness the socking of calabash in water or socks the wilted calabash in a bowl of water for some time and allow it to absorb water to enable the calabash be shaped well

iii. The students are asked to record their observations.

iv. The teacher neatly peels yam tuber/sweet potato and cut them into 2. He then cuts a u-shaped hole in the center of each of the cut off yam/sweet potato

v. The teacher labels the two potatoes as" specimens A and B".

vi. The teacher adds salt in the hole on specimen A leaving that of B empty

vii. The teacher gently lowers the two specimen into a water bowl such that 1/3 of the specimen. Allow the experiment to stand for 24 hours.

viii. Observe the level of the liquid in specimens A and B.

ix. What is the name of the process involved?

x. The teacher explains the process as water molecules moving from a region of lower concentration to another region of higher concentration the process is called osmosis. It has the following advantages:

Evaluation

The lesson will be evaluated by making students to answer the following questions.

1. Explain the concept of osmosis;
2. Identify factors that determine its occurrence
3. Identify its application in everyday life.

Lesson plan for experimental group (Ethnoscience-based instruction)

Name of Researcher: Anane Simon

Subject: Integrated Science

Topic: Mixture

Level of Group: J.H.S. 2

Average age of Students: 14

Sub topics:

Some methods of separating mixtures

i. evaporation to dryness
ii. decantation
iii. filtration
iv. separation of immiscible liquids

Entry Behaviour:

The students are used seeing their parents separate rice from stones; preparing „*akamu'* paste, washing of rice or any grain to prepare food.

Instructional Materials:

water, pot, heat source (preferably firewood), scenes of a woman filtering akamu, washing of grains for cooking.

Behavioural Objectives:

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

i. Demonstrate that mixtures can be separated using physical methods;
ii. Identify the principle behind separation of a given mixture
iii. Collect and purify water from streams or any impure source

Activity1: Evaporation

Introduction

i. The teacher explains that when mothers cook, they usually add more water into the raw food and put on a stove. After the cooking the water is nowhere to be found. Where does the water goes?
ii. The teacher asks students the question that: Suppose that your brother pours water into your mother‟s salt, how would you recover the salt?

iii. The teacher mix 2 spatula full of common salt with 20ml of water in a beaker

iv. The solution is poured into an evaporating dish

v. Heat the solution to dryness over a bath to avoid spattering (scattering) of the solution during heating.

vi. What do you observe?

Activity 2: Filtration

Materials needed: a scene/picture of filtering akamu, filter paper, funnel, conical flask, water from different sources.

i. The teacher asks the students on their experience in the filtration of akamu.

ii. The students are made to place the funnel on the conical flask

iii. Fold the filter paper to form a cone

iv. Place the folded filter paper into the funnel

v. Pour the water through the filter paper,

vi. What do you observe, how do you relate what you have done with that of akamu filtration?

vii. What name do you give to the solid collected on the filter paper and the water collected in the conical flask?

Evaluation:

the teacher asks the students some questions at intervals to ascertain that the students are following.

Conclusion.

The lesson will be concluded by the teacher reviewing what was presented to the students and giving the short notes for revisions.

Evaluation

The lesson will be evaluated by asking students to conduct one or more of the activities they were exposed to.

APPENDIX B

Lesson plan for Control group (Lecture Method)

Name of Researcher: **Anane Simon**

Subject: **Integrated Science**

Topic: **Acids**

Level of Group: **J.H.S. 2**

Average age of Students: **14**

Entry behaviour:

the students are used to feeding/eating from materials that have sour taste.

Instructional Materials:

litmus paper, HCl, H_2SO_4 (dilute)

Behavioural Objectives:

at the end of the lesson, a student should be able to: -

i. define acids;
ii. Identify the properties of acids
iii. Identify an acidic solution
iv. Mention some examples and sources of acids
v. Mention uses of acids
vi. Arrange an acid/base titration
vii. Produce salt from acid/base reactions

Step 1: Introduction.

The teacher introduces the lesson by narrating a simple story of a fight between two people. When the two people were separated, one of them picked a bottle containing some liquid and poured the liquid on the face of his co - fighter. Immediately, the man's face got burnt. (the teacher and students further discuss the incidence and its implications)

Step 2: Presentation

Meaning of acids

The teacher explains the concept of acid as any substance that releases a hydrogen ion as the only free ion when dissolved in water. Any substance that changes blue litmus paper red.

Properties of acids

The teacher with the students enlists the properties of acids as follows

i. It changes blue litmus paper red
ii. It is corrosive;
iii. It has sour taste;
iv. It neutralizes bases;
v. It reacts with metals to liberate hydrogen.

Examples of acids

The teacher explains that acids are broadly categorized into organic and inorganic acids. He/she goes further to mention the examples of the acids.

Sn	Organic Acids		Inorganic Acids	
	Names	Source	Names	Source
1	Ethanoic Acid	Vinegar	Tetraoxosulphate VI acid	H_2SO_4
2	Lactic Acid	Milk	Trioxonitrate IV acid	HNO_3
3	Citric Acid	Lemon	Hydrochloric acid	HCl
4	Amino Acids	Proteins		
5	Fatty Acids	Fats & Oil		

Sources of acids

Organic acids

i. unripe orange
ii. lemon
iii. tamarind

Evaluation

The lesson will be evaluated by making students to answer some questions.

define acids;

1. Identify three (3) properties of acids
2. Mention three (3) examples and sources of acids
3. Mention two (2) uses of acids
4. Produce salt from acid/base reactions

Conclusion:

The teacher concludes by giving the students the following notes

An acid is a substance which produces hydrogen ion (proton) as the only positive ion when dissolved in water.

Properties of acids:

i. acids have sour taste;
ii. acids change blue litmus paper red,
iii. acids are corrosive;
iv. acids neutralize bases

Uses of Acids

i. as foods
ii. production of soap
iii. HNO_3 for production of fertilizers
iv. HCl for removal of rust
v. H_2SO_4 as electrolyte in acid accumulators

Name of Researcher:	Anane Simon
Subject:	Integrated Science
Topic:	Bases
Level of Group:	J.H.S. 2
Average age of Students:	14

Entry behaviour:

The students are used to feeding/eating from materials that have bitter taste; they are used to seeing their mothers add potash into sour soups, etc.

Instructional Materials:

litmus paper sodium/potassium hydroxide solution

Behavioural Objectives:

at the end of the lesson, students should be able to: -

i. define bases;
ii. Mention/list the properties of bases
iii. Mention some examples and sources of bases
iv. Mention uses of bases
v. Produce salt from acid/base reactions

Step 1: Introduction.

The teacher observes that teacher introduces the lesson by presenting some beakers containing liquids. He asks students to dip litmus papers into the different liquids and observes what happens.

Step 2: Presentation

The teacher explains that bases are substances that changes red litmus paper blue. It is also a substance which can combine with hydrogen ion when dissolved in water.

Step 3:

- the teacher asks students to dissolve sample bases in water;
- the teacher asks the pupils to dip blue and red litmus papers into the solutions and record their findings;
- the teacher asks the students if there was anything they observe from what they did so far;

- the teacher repeats the questions posed at the introduction

Conclusion:

The teacher concludes by giving the students the following notes

A base (alkali) is a substance which can combine with hydrogen ion when dissolved in water.

Properties of bases:

i. bases have bitter taste;
ii. bases change red litmus paper blue,
iii. concentrated forms bases are corrosive;
iv. they are soapy to touch;
v. Bases neutralize acids

Examples and uses of bases

Locally bases are used in the cooking of food (e.g. in cooking of beans, in neutralizing the sour taste of stew) and in emulsification of pounded guinea corn

Bases are also used locally to manage stomach offsets. Standard bases are however used in the followings.

Sn	Names	Formula	Uses
1	Sodium Hydroxide	NaOH	Manufacture of soap, plastics and petrol refining.
2	Potassium Hydroxide	KOH	Manufacture of liquid soap, dying and electroplating
3	Calcium Hydroxide	$Ca(OH)_2$	For production of cement and tooth paste
4	Magnesium Hydroxide	MgOH	As laxative

Evaluation

The lesson will be evaluated by making students to answer the questions as follows:

1. Mention/list three (3) properties of bases
2. Mention three (3) examples and sources of base
3. Mention two (2) uses of bases

Name of Researcher: Anane Simon

Subject: Integrated Science

Topic: Force

Level of Group: J.H.S. 2

Average age of Students: 14

Entry Behaviour:

The students are used to pushing and pulling objects to make them move, playing with strings to produce a rotation on a tied circular body, removing/separating maize grain from its cob.

Instructional Materials:

catapult, fixed doors, strings, metal bottle tops or tin covers,

Behavioural Objectives:

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

i. Explain the concept of force;
ii. Apply force to operate a machine;
iii. Solve arithmetical problems involving forces;
iv. Demonstrate balanced and unbalanced forces;
v. State the principle of moment;
vi. Solve the simple problems involving the equilibrium of forces; -
vii. Explain friction.

Step 1: Introduction.

The teacher introduces the lesson by telling a story in which pupils are fighting, one of the strongly pushed the other to fall of his feet. He asks why the second pupil fall off. the following questions.

Activity 1:

definition of force

Step 1: Presentation

i. The teacher defines force as that which changes or tends to change the state of motion of a body. It occurs as a push or a pull.

ii. the teacher explains the relationship between force and movement as well as derive the mathematical relationship.

iii. The teacher solves some simple problems involving forces.

Types of forces:

i. Field force – centrifugal, centripetal, magnetic, gravitational forces etc.

ii. Contact forces – push, pull

Effect of forces on bodies

The teacher explains the effect of forces on bodies:

i. Forces cause movement;

ii. ii. It deforms bodies;

iii. iii. Makes objects to stop moving;

iv. iv. Frictional forces allow us to move on surfaces without slipping off.

Activity 2:

balanced and unbalanced forces

Conclusion

The teacher concludes the lesson by giving the students the following notes.

Forces: is either a push or a pull. It is that which changes or tend to change the state of motion of a body. Usually, when an object is at rest, (not moving) the sum of the forces making it to move and that which is stopping from moving is equal to zero.

Thus, for an object to move, an additional force that will overcome the force making it not to move is needed. Thus, the more the force, the more the movement.

Force is mathematically defined as

$F \alpha a$

Where F = force a = acceleration

Thus, inserting a constant to make the proportionality a constant, the basic factor that determines the effects of force on acceleration of a body is the mass of the body. Therefore, we‘ve

$F = ma$

The unit of force is the Newton (N)

Effects of force on bodies

i. It causes motion,
ii. retard or stop motion;
iii. It leads to the deformation of the shape of objects;
iv. It causes the breakage of objects

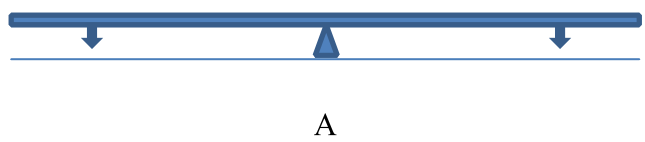
Example.

A body of mass a body of mass 5kg is acted upon by a force that makes it moves at $5m/s^2$ if the body moves through a distance of 10m in 2 seconds, calculate the magnitude of the force that acted on the body

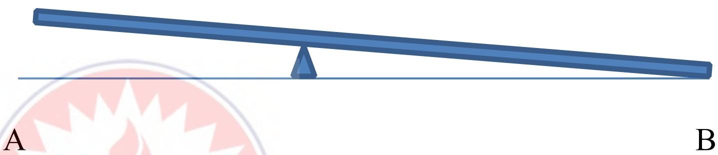
The magnitude of the force (F) that acted on the body
F = Mass x Acceleration $F = M \times a$ $F = 5kg \times 5m/s^2$ $F = 25\ kgm/s^2$ F = 25N

Balanced forces (moment of a force)

The teacher explains the concept of balanced forces as two or more forces that act on a body to keep it at equilibrium (Stable position). They can be Parallel forces acting in the same direction with one another. They can act vertically downwards, upwards or horizontally. In the example given below, the forces acting on either side of the fulcrum (A) are equal when the wood stabilizes on the fulcrum. As shown below.



a)



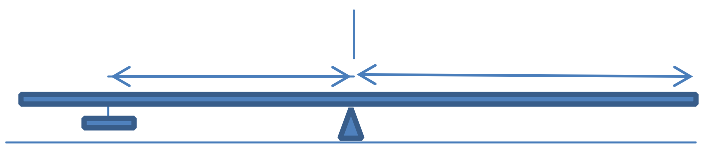
b)

a) a body balanced on a fulcrum; equal forces act on either sides of the body.

b) a body unbalanced on a fulcrum; more forces act on side B than A of the body

the unbalance in the forces acting on a body makes the body to move about a given point (fulcrum) this movement is called the turning effect of forces or principle of moment.

The moment of a force about a point is defined as the product of force and the perpendicular distance from the point of the line of action. From the above therefore, the principle of moment states that *when a body is in equilibrium under the action of several forces, the sum of clockwise moments about any point is equal to the sum of anticlockwise moment.*



Thus, the position at which a given mass would be hung to make the body balanced can be calculated by the formula:

Clockwise moment = W_1 x OA

Anticlockwise moment = W_2 x OB

Thus, W_1 x OA = W_2 x OA

Example 1: a stone of mass 30g was hung at one end of a wooden metre rule at 30cm mark from one edge. At what point on the other side will a mass of 25g be hung to keep the rule at equilibrium?

Example 2: a bar pivoted at O, has forces 30g and 20g acting at 30cm and 10cm respectively from one side of O. find the point on the other side at which a 50g force will need to act in order to keep the bar at equilibrium.

Friction

Friction is the force that opposes motion.

Effects of friction on bodies

i. It causes wear and tear

Evaluation

The lesson will be evaluated by making students to answer questions as follows

Explain the concept of force;

1. Apply force to operate a machine;
2. Solve arithmetical problems involving forces;
3. Demonstrate balanced and unbalanced forces;
4. State the principle of moment;
5. Solve the simple problems involving the equilibrium of forces;
6. Explain friction

Name of Researcher: Anane Simon

Subject: Integrated Science

Topic: Density

Level of Group: J.H.S. 2

Average age of Students: 14

Entry Behaviour:

The students are used seeing objects fly in the air. their parents separate rice from stones; winnowing to separate grains from chaff, they are used to seeing ships, boats/canoes floating on water with all their loads.

Instructional Materials:

stone, plastic bottle, water, large container.

Behavioural Objectives:

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

i. Explain the density;

ii. Compute the magnitude of the densities of bodies;

iii. Identify the applications of density

Step 1: Introduction.

i. The teacher introduces the lesson by explaining the concept of density;

ii. The teacher drops a piece of stone in water and the plastic bottle (bigger than the stone in water) and allow students to make observation of which of the two will sink or float.

iii. The teacher defines density as the ratio of the measure of mass of a body to that of its volume.

Mathematically: density =mass/volume

Step 2: computation of densities

Density = mass/volume

Example: a body of volume $5cm^3$ has a mass of 2g. calculate the density of the body.

Density = 2/5

= $0.4\ g/cm^3$

Evaluation

The lesson will be evaluated by making students to answer the questions

1. Explain the density;
2. Compute the magnitude of the densities of bodies;
3. Identify the applications of density

Name of Researcher:	Anane Simon
Subject:	Integrated Science
Topic:	Digestive System
Level of Group:	J.H.S. 2
Average age of Students:	14

Entry Behaviour:

The students are used to feeding and can identify the benefits of eating. The students are also aware that the foods they eat undergo some changes after they ate, and it is evident in their stool.

Instructional Materials:

chart of human alimentary canal

Behavioural Objectives:

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

i. Identify parts of alimentary canal;
ii. Describe the roles of the different parts play in digestion;
iii. Describe digestion and absorption processes;
iv. Draw the parts of the alimentary;
v. Explain the end product of digestion of food.

Step 1: Introduction.

i. Teacher explains digestive system as a process by which foods taken by animals are broken down into simple substances for absorption into the blood stream.

ii. The use of the chart is to show and explains to the students the various parts of the alimentary canal, the teacher also explains the function of each of the parts.

Evaluation

students will be made to answer the questions as follows

1. Identify parts of alimentary canal
2. Describe the roles of the different parts play in digestion;
3. Describe digestion and absorption processes
4. Draw the parts of the alimentary
5. Explain the end product of digestion of food

Conclusion

The teacher concludes by given the followings as the summary of the lesson Digestion is the process by which food is broken down into simple, soluble substances by mechanical and chemical means for the body to absorb and use. This process occurs in the alimentary canal in human and other high animals.

The alimentary canal

The alimentary canal is a long tube that starts from the mouth and ends at the anus. It is made up of different organs and most of it is coiled up in the abdominal cavity. The components of the alimentary canal are summarized in the diagram below:

Roles of the parts of the alimentary canal

Part of Alimentary Canal	**Function**
Mouth	3. The process of digestion starts from the mouth. As food gets into the mouth, it is broken down/grinded mechanically by the teeth. 4. Grinded food mixes with saliva which contains an enzyme (ptyalin) that is responsible for the convert starch to soluble sugar
Oesophagus	2. The function of oesophagus is to push food from the mouth to the stomach through peristalsis.
Stomach	3. The main function of the stomach is to mix food with water to produce a smooth pulp called chime through mechanical movement of the walls of the stomach 4. The walls of the stomach secretes gastric juice which helps to convert part of protein into soluble form
Small Intestine	Food digestion is completed here by the secretion of the following juices. 3. Pancreatic juice: contains: i. Amylopsin - carbohydrate ii. Trypsin - protein iii. Lipase – fats 4. Digested foods are absorbed into the blood by ls of the wall the small intestine.
Large intestine	This is not a digestive organ, it is main function is the reabsorption of water and passing out of the undigested food through the anus

Name of Researcher: Anane Simon

Subject: Integrated Science

Topic: Osmosis

Level of Group: J.H.S. 2

Average age of Students: 14

Entry Behaviour:

Student have seen liquids flowing before

Instructional Materials:

Irish potato/yam, knife, water, common salt.

Behavioural Objectives:

at the end of the lesson, a student should be able to:

i. Explain the concept of osmosis
ii. Demonstrate the process of osmosis
iii. Explain the bases of the basis of the movement water molecules
iv. Explain the osmosis importance in everyday life;

Step 1: Introduction.

The teacher introduces the lesson by defining osmosis as the process by which water molecules move from region of lower concentration to that of higher concentration through a semi permeable membrane.

i. The teacher neatly peels yam tuber/sweet potato and cut them into 2. He then cuts a u-shaped hole in the centre of each of the cut off yam/sweet potato; iii. The teacher labels the two potatoes as „specimens A and B‟.
ii. The teacher adds salt in the hole on specimen A leaving that of B empty;

iii. The teacher gently lowers the two specimen into a water bowl such that 1/3 of the specimen is in water. Allow the experiment to stand for some time hours.

iv. The teacher makes students to make and record their observations on the level of the liquid in specimens A and B.

v. What is the name of the process involved?

vi. The teacher explains the process as water molecules moving from a region of lower concentration to another region of higher concentration the process is called osmosis.

Evaluation

The lesson will be evaluated by making students to answer the questions:

i. Explain the concept of osmosis

ii. Demonstrate the process of osmosis

iii. Explain the basis of the movement of water molecules

iv. Explain their importance in everyday life;

Name of Researcher:	Anane Simon
Subject:	Integrated Science
Topic:	Mixtures
Level of Group:	J.H.S. 2
Average age of Students:	14

Methods of separating of mixtures

i. Evaporation

ii. decantation

iii. filtration

iv. separation of immiscible liquids

Entry Behaviour:

The students are used separating substances based on size, color or shape.

Instructional Materials:

beakers, filter paper, separation funnel, pot, source of heat.

Behavioural Objectives:

at the end of the lesson, a student should be able to:

i. Demonstrate that mixtures can be separated using physical methods

ii. Identify the principle behind separation of a given mixture

iii. Collect and purify water from streams or any impure source

Activity1: Evaporation

Introduction

The teacher introduces the lesson by explaining to the students that substances natural occur in mix form and need to be separated to be used. The teacher asks students the question that: Suppose that your brother pours water into your mother's salt, how would you recover the salt?

i. The teacher explains that when water is heated, it vaporizes. Thus, dissolved solids can be separated from liquids by evaporation. Though the water may not be regained.
ii. The teacher mix 2 spatula full of common salt with 20ml of water in a beaker;
iii. The solution is poured into an evaporating dish;
iv. Heat the solution to dryness over a bath to avoid spattering (scattering) of the solution during heating.
v. What do you observe?

Activity 2: Filtration

Materials needed: filter paper, funnel, conical flask, water from different sources.

The teacher explains the concept of filtration as a process of separating insoluble solids from a liquid.

The teacher demonstrate the process as follows:

i. place the funnel on the conical flask;
ii. Fold the filter paper to form a cone;
iii. Place the folded filter paper into the funnel;
iv. Pour the water through the filter paper,

v. What name do you give to the solid collected on the filter paper and the water collected in the conical flask?

Evaluation:

The teacher asks the students some questions at intervals to ascertain that the students are following.

Evaluation

The lesson will be evaluated by making students to employ one or two methods above to separate the components of a given mixture.

Conclusion.

The lesson will be concluded by the teacher reviewing what was presented to the students and giving them short notes for revisions.

Appendix C

Integrated Science Performance Test (ISPT) before pilot test

Integrated Science performance science

Name of student ……………………………………………..…….

Sex: M ( ) F ( ) please tick.

School ……………………………………………………………….

Location: Urban……………. Rural……………………

Age……………………………

Instructions: Answer all questions on this paper.

1. Friction can be reduced in a machine by the use of ….

a) Grease b) Heat c) Smoothening bodies d) Pliers

2. Which of the followings provides a mechanical breakdown of food during digestion in the mouth?

a) Tongue b) Teeth c) Saliva d) None

3. The enzyme in saliva that breaks down food substances is called?

a) Ptyalin b) Pancreatic Juice c) Insulin d) None

4. The formular for calculating force is….

a) F = Ma b) F α M c) F = M d) F α a

5. In which of the following methods of separation of mixtures are based on their densities?

a) Winnowing b) Sieving

c) Distillation d) Filtration

6. What is the name given to the process by which food substances are broken down into simpler forms ready to be absorbed by the body?

a) Respiration b) digestion

c) Excretion d) Growth

7 The end product of digestion of starch is known as………………

a) Glucose b) Glycogen

c) Fat d) Nitrogen

8. Calculate the density of a body of volume $4cm^3$ and mass 8g.

a) $4g/cm^3$ b) $8g/cm^3$ c) $2g/cm^3$

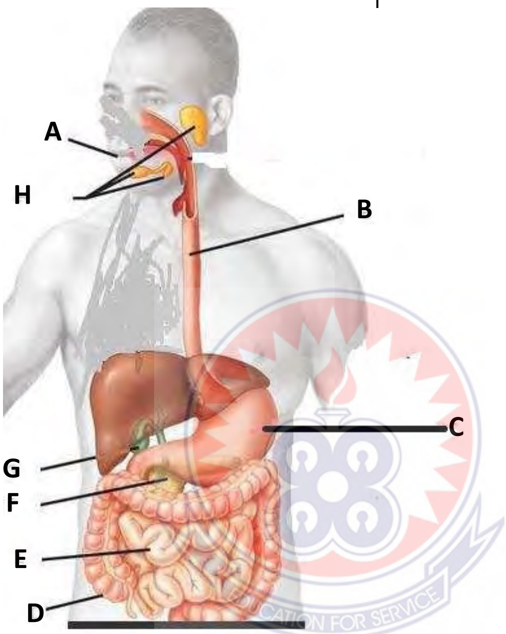
d) $0.5g/cm^3$

9. The principal products between the reaction of acid and base are …

a) Water and Salt b) Water and Acid

c) Water and Base d) soap

10. All bodies with a density of 1 will sink in water. True or False



USE THE DIAGRAM ABOVE TO ANSWER QUESTIONS 11, 12, 13 and 14.

11. The part labelled C is called ….

a) Liver b) Stomach c) Oesophagus

d) mouth

12.At what part of the diagram does absorption of digested food takes place?

a). E b) G c) F d) C

13.The part of the digestive system that produce pancreatic juice is …...

a) G b) E c) F d) D

14. Chewing occurs in the part labelled.

a) G b) A c) C d) E

15.In what form are carbohydrates absorbed into the body?

a) Glucose b) Sucrose c) Cum

d) Sugar

16. A solution that changes red litmus paper blue is acidic.

True or False?

17. The reaction between an acid and a base is called ….

a) Substitution reaction
b) Chemical reaction
c) Neutralization reaction d) None

18.Which of the followings is not a characteristic property of an acid?

a) Turns blue litmus paper red

b) It is sour in taste

c)It is corrosive

d) It forms in air

19. Two bodies A and B were thrown into water, A floats and B sank. Which amongst the followings simply explains the sinking of the former?

a) A is denser than B

b) A is heavier than B

c) B is denser than A

d) B is heavier than A

20. The function of the large intestine is…………..

a) Reabsorption of water

c) Breakdown of food

b) Absorption of food

d) Storage of food

21. Which of the followings does not describe the effect of forces on bodies?

a) Movement b) Wear and Tear

c) Deformation d) None

22. A boy pushed a cart of mass 5kg at $2m/s^2$. What is the amount of force applied?

a) 5N b) 2N c) 10N d) 20N

23. The force that peels off two bodies in contact is called ….

a) Frictional force

b) Magnetic Force

c) Gravitational Force

d) centripetal force

24. A body of mass 10kg is placed at 30cm from the fulcrum of a uniform meter rule. At what point will another body of equal mass be placed to balance the meter rule on the fulcrum?

a) 20cm b) 40cm c) 30cm d) 15cm

25.The S.I unit for force is ….

a) Kilogram b) Newton c) M/s d) Hp

26.During osmosis, water molecules move a region of …. ……….

a) higher concentration to that of lower concentration

b) lower concentration to higher concentration

c) dry environment to wet environment

d) none

27. The term given to the movement swallowed food from the mouth to the stomach is called ….

a) Osmosis b) Mitosis c) Peristalsis d) Meiosis

28. Which of the following is not meant for separating liquid from insoluble solid?

a) Separating Funnel b) Filtration

c) Decantation d) None

29. In preparation of *ink*, the separation technique used is ……

a) Sedimentation b) distillation

c) Chromatography d) Filtration

30. When a person tastes a lemon, he feels some irritation on his tongue this feeling shows the …….

a) Corrosive nature of acids

c) Composition of the lemon

b) Corrosive nature of base S

d) None

APPENDIX D

Marking Scheme for pre test

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

APPENDIX E

Integrated Science Performance Test (ISPT) after pilot test

Integrated Science performance science

Name of student ……………………………………………………

Sex: M ( ) F ( ) please tick.

School ……………………………………………………………

Location: Urban……………. Rural……………………

Age………………………

Instructions: Answer all questions on this paper.

1. Friction can be reduced in a machine by the use of ….

a) Grease b) Heat c) Smoothening bodies d) Pliers

2. Which of the followings provides a mechanical breakdown of food during digestion in the mouth?

a) Tongue b) Teeth c) Saliva d) None

3. The enzyme in saliva that breaks down food substances is called?

a) Ptyalin b) Pancreatic Juice c) Insulin d) None

4. The formular for calculating force is….

a) F = Ma b) F α M c) F = M d) F α a

5. In which of the following methods of separation of mixtures are based on their densities?

a) Winnowing b) Sieving c) Distillation d) Filtration

6. What is the name given to the process by which food substances are broken down into simpler forms ready to be absorbed by the body?

a) Respiration b) digestion c) Excretion d) Growth

7 The end product of digestion of starch is known as……………….

a) Glucose b) Glycogen c) Fat d) Nitrogen

8. Calculate the density of a body of volume 4cm^3 and mass 8g.

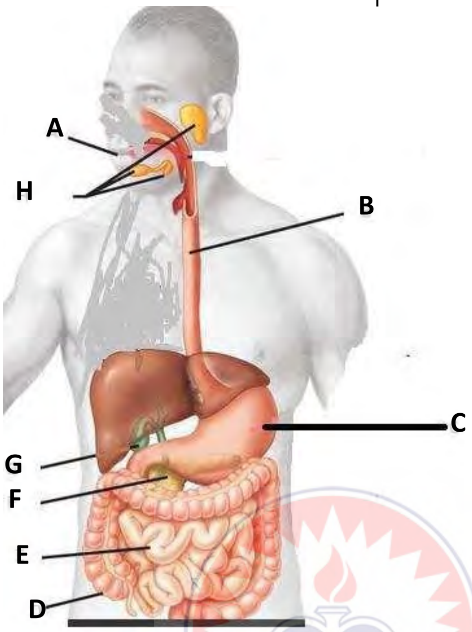
a) 4g/cm^3 b) 8g/cm^3 c) 2g/cm^3 d) 0.5g/cm^3

9. The principal products between the reaction of acid and base are ....

a) Water and Salt b) Water and Acid

c) Water and Base d) soap

10 All bodies with a density of $1g/cm^3$ will sink in water. True or False



USE THE DIAGRAM ABOVE TO ANSWER QUESTIONS 11, 12, 13 and 14.

11 The part labeled C is called ….

a) Liver b) Stomach c) Esophagus d) mouth

12.At what part of the diagram does absorption of digested food takes place?

a). E b) G c) F d) C

13.The part of the digestive system that produce pancreatic juice is …..

a) G b) E c) F d) D

14. Chewing occurs in the part labeled

a) G b) A c) C d) E

15.In what form are carbohydrates absorbed into the body?

a) Glucose b) Sucrose c) Cum d) Sugar

16. A solution that changes red litmus paper blue is acidic. True or False?

17. The reaction between an acid and a base is called ….

a) Substitution reaction
b) Chemical reaction
c) Neutralization reaction
d) None

18.Which of the followings is not a characteristic property of an acid?

a) Turns blue litmus paper red

b) It is sour in taste

c)It is corrosive

d) It forms in air

19. Two bodies A and B were thrown into water, a floats and B sank. Which

amongst the followings simply explains the sinking of the bodies?

a) A is denser than B

b) A is heavier than B

c)B is denser than A

d) B is heavier than A

20. The function of the large intestine is ……………

a) Reabsorption of water

b) Breakdown of food

c) Absorption of food

d) Storage of food

e)

f)

g)

21. Which of the followings does not describe the effect of forces on bodies?

a) Movement b) Wear and Tear

c) Deformation d) forces

22. A boy pushed a cart of mass 5kg at $2m/s^2$. What is the amount of force applied?

a) 5N b) 2N c) 10N d) 20N

23. The force that peels off two bodies in contact is called ….

a) Frictional force

b) Magnetic Force c) Gravitational Force

d) centripetal force

24. A body of mass 10kg is placed at 30cm from the fulcrum of a uniform meter rule. At what point will another body of equal mass be placed to balance the meter rule on the fulcrum?

a) 20cm b) 40cm c) 30cm d) 15cm

25.The S.I unit for force is ….

a) Kilogram b) Newton c) M/s

d) Hp

26.During osmosis, water molecules move a region of …. ………

a) higher concentration to that of lower concentration

b) lower concentration to higher concentration

c) dry environment to wet environment d) none

27. The term given to the movement swallowed food from the mouth to the stomach is called ….

a) Osmosis b) Mitosis c) Peristalsis d) Meiosis

28. Which of the following is not meant for separating liquid from insoluble solid?

a) Separating Funnel b) Filtration

c) Decantation d) None

29. In preparation of *ink*, the separation technique used is ……

a) Sedimentation b) distillation

c) Chromatography d) Filtration

30. When a person tastes a lemon, he feels some irritation on his tongue this feeling show the …….

a) Corrosive nature of acids

c) Composition of the lemon

b) Corrosive nature of base

d) None

APPENDIX F

Marking Scheme for pre test

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

APPENDIX G

The Students' Attitude towards Integrated Science Questionnaire Draft

Dear Respondent,

The bearer of this research instrument is a Master's student in the Department of Science Education, Faculty of Science Education, University of Education, Winneba. The items presented are designed to determine the degree of your attitude towards Integrated Science using Ethnoscience learning approach. You are therefore requested to rate yourself on the questionnaire items. You are guaranteed the utmost confidentiality as the information provided will be used strictly for this research only.

Yours faithfully,

Anane Simon

GENDER: MALE [ ] **FEMALE [ ]**

Instruction: *Please tick* (√) *the appropriate column that suits your interest.*

Please take note of the following KEYS: **SD-Strongly Disagree,**

D- Disagree,

N-Neutral,

A-Agree,

SA-Strongly Agree

SN	ITEMS	SA	A	U	D	SD
1	I believe science is simple therefore I want to study it.					
2	I like science subjects because my parents are scientists.					
3	My parents regularly advise me to study science.					
4	Science is for the very intelligent students.					
5	Science is concerned with understanding how the natural world works.					
6	Scientists can believe in God or a supernatural being and still do good science.					
7	I will not do science because it changes one's faith.					
8	I see science as the magic of the white man.					
9	I do not see anything science in what I do every day.					
10	My teachers do not relate science to my everyday activity.					
11	I easily understand science because I am interested in it.					
12	I lose interest whenever it is time for science lesson.					
13	My major problem with science is the calculations it contains.					