IMPACT OF ETHNOSCIENCE-ENRICHED-INSTRUCTION ON ATTITUDE, RETENTION AND PERFORMANCE IN BASIC SCIENCE AMONG RURAL AND URBAN STUDENTS IN KANO STATE, NIGERIA

BY

Hussaini Yahaya PENI,
B. Sc. (1997) UDUS; PGDE (2004) BUK; MED (2009) ABU.
Ph.D/EDUC/9615/2010-2011

A THESIS SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES AHMADU BELLO UNIVERSITY ZARIA, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF DEGREE OF DOCTOR OF PHILOSOPHY IN SCIENCE EDUCATION.

DEPARTMENT OF SCIENCE EDUCATION,

FACULTY OF EDUCATION,

AHMADU BELLO UNIVERSITY,

ZARIA, NIGERIA.

DECLARATION

I hereby declare that this thesis entitled “Impact of Ethnoscience-enriched-instruction on Attitude, Retention and Performance in Basic Science among Rural and Urban Students in Kano State, Nigeria” has been written by me and that it is the record of my own research work. It has not been presented in any previous application for higher degree. All quotations and sources of information are specifically acknowledged by means of references.

_____ _____

Hussaini Yahaya PENI Date

CERTIFICATION

This thesis entitled "Impact of Ethnoscience-enriched-instructions on Attitude, Retention and Performance in Basic Science Among Rural and Urban Students in Kano State, Nigeria" by Hussaini Yahaya Peni (PhD/EDUC/9615/2010-2011) meets the regulations governing the award of degree of Doctor of Philosophy in Science Education of the Ahmadu Bello University, and is approved for its contribution to knowledge and literary presentation.

_____ _____

Dr. S. B. Olorukooba — Date
Chairperson, Supervisory Committee

_____ _____

Professor I. A. Usman — Date
Member, Supervisory Committee

_____ _____

Dr. F. K. Lawal — Date
Member, Supervisory Committee

_____ _____

Dr. M. Musa — Date
Head, Department of Science Education

_____ _____

Professor K. Bala — Date
Dean, School of Postgraduate Studies

DEDICATION

This piece is dedicated to my late mother Hajiya Zainab (Chintomo) for her enduring motherly care. May her Gentle Soul Rest in Peace, Amen!

ACKNOWLEDGEMENTS

All praises are due to Allah the Lord of the universe, who granted me life and health to pursue and complete this program. May the peace and blessings of Allah be upon his noble Prophet, Muhammad, the son of Abdullah (Sallallahu alaihi wa sallam), his family, his companions and those that followed his path till the day of reckoning.

Works of this sort are never the effort of an individual but a collection of efforts. On this note, I wish to express my profound gratitude to Dr S. B. Olorukooba; Professor I. A. Usman; and Dr. F. K. Lawal (my first, second and third supervisors respectively) for their constructive comments, criticisms and suggestions that made this work a reality. My sincere appreciations goes to Dr. S. S. Bichi, Professor J. S. Mari, Dr. B. Abdulkarim, Dr. J. O. Olajide, Dr. M. A. Lakpini, Dr. S. S. Obeka, all of Science Education Department for their professional guidance throughout the period of this study.

The memory of my late beloved mother is fresh in me. I pray Allah to grant her Jannatul firdaus. I appreciate the prayers of my humble step mother Hajiya Rabi Yahaya. May Allah strengthen her and give her good health. My appreciation also goes to my beloved wife (Lubabatu Umar) for her patience and moral support; my humble children: Ahmad, Rabi'atu (Walida), Umar (Walid), Hajara (Mama), and little Zainab (that just joined the family) for their enduring patience, company and prayers that gave me courage to pursue this work to its end.

I also thank the principals, Basic Science teachers and students of the GSSS Bichi and GGJSS Bude for their permission and participation in the pilot study. Worthy of appreciation are also the principals, Basic Science teachers and students of the 8 schools involved in the main study.

I also acknowledge the support I enjoyed from my sisters: Hajiya Hadiza Ibrahim Gujiya, Hajiya Maimuna Sa'eed Dankolo (and her husband Alhaji Sa'eed Muhammad Dankolo), Hajiya A'ishatu Yahaya (and her husband, Alhaji Umaru Marafa), Malama Mairo Yage, Hajiya Fatima Yahaya, Malama Safiya (Ladi), Malama Amina (Lami); and my brothers: Malam Hassan (Babba), Malam Hassan (Karami), Malam Sani (Danlami) and Architect Adamu (Auta). I wish all of them Allah's blessings.

I shall not forget my classmates whose warm interaction has made a serious impact in my study life. They include Malam Dalhatu Haruna Zarewa and Malam Labaran Inuwa Jahun. I also appreciate the patience of my friends and co-workers at the Federal College of Education (Technical) Bichi. Notable among them are Malam Dayyabu Muhammad Waire, Bello I. Kangiwa, Mahdi, G. D., M. S. Yunusa, Tijjani A. Muhammad, Isma'il A. Abubakar, K. S. Abdullahi, F. O. Darda, F. O. Olatunji, Madu, C. I. and others too numerous to mention in this limited space.

LIST OF ABBREVIATIONS

BSPT:	Basic Science Performance Test
SABSQ:	Students Attitude to Basic Science Questionnaire
JS II:	Junior Secondary II

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.

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ABSTRACT

This study investigated the Impact of Ethnoscience-enriched-instruction on Attitude, Retention and Performance in Basic Science among Rural and Urban Students. The study employed a pretest posttest quasi experimental design. A randomly selected sample of 213 students from 8 schools under the Bichi Education zone was used for the study. The schools were randomly assigned into experimental and control groups containing male and female schools from urban and rural locations. The experimental groups were taught concepts using Ethnoscience-enriched-instructions while the control groups were taught using lecture method. The groups were posttested to determine their academic performance and attitude after the treatment. They were furthers tested (post-posttest) to determine the retention of learnt concepts. Data were collected using the Basic Science Performance Test (BSPT), a 25 item multiple choice test with a reliability coefficient of 0.66; and the Students Attitude to Basic Science Questionnaire (SABSQ) developed on a five point Likert's scale with a reliability coefficient of 0.75. The data were analyzed to answer the research questions and test the null hypotheses. The research questions were answered using descriptive statistics. The hypotheses on academic performance were tested using the two way ANOVA and t-test statistic, while those on attitude were tested with Kruskal Wallis H test and Mann Whitney U test at 0.05 level of significance. The study found that Urban and Rural students in the experimental groups performed better than those in the control groups ($F(1, 209) = 287.63$; $p \leq 0.05$). It also found that the instructional process had enhanced the performance and attitude of students to Basic Science ($X^2(3) = 133.05$; $p < 0.05$). Similarly, Urban and Rural students in the experimental groups had significantly better retention of learnt concepts ($F(1, 208) = 10.512$; $p < 0.05$). The study concludes that the instructional process is a viable innovation to the enhancement of rural and urban students' academic performance, retention of concepts and attitude to Basic Science and it is gender friendly. The study recommends that teachers should use ethnoscience-enriched-instructions in their teaching. Methodology courses in pre-service teacher training should include ethnoscience-enriched-instruction. At the in-service level, seminars and workshops should be organized to educate practicing teachers on how to use ethnoscience-enriched-instruction in teaching.

CHAPTER ONE
THE PROBLEM

1.1 Introduction

The improvement of science literacy among citizens is a vital tool for economic, social and individual development in any country. In appreciation of this, the Federal Government of Nigeria emphasized the introduction of science subjects (Basic Science & Technology at the lower basic level and Basic Science at the upper basic level of the school system). This is to enable citizens acquire the knowledge of their environment, develop problem solving skills, develop desirable scientific attitudes, as well as increase their understanding of the role and functions of science in everyday life (NCCE, 2012).

Basic Science, formerly known as Integrated Science, is the form of science a child encounters at the Upper Basic (Junior Secondary) level. It prepares students for the study of core science subjects (Physics, Chemistry, and Biology) at the Senior Secondary School level. This implies that for a student to be able to study specialized science subject at the Senior Secondary School level, she/he has to be well grounded in Basic Science at the Junior Secondary level. With this in mind, the Basic Science Curriculum was prepared with the following objectives to: provide students with a sound basis for continuing science education either in single science subjects or further Integrated Science; enhance the scientific literacy of the citizenry; allow students understand their environment in its totality rather than in fragments; and allow students to have general view of the world of science; (Danmole, 2011).

Studies in Basic Science have revealed that students have developed negative attitudes towards the subject (Okebukola, 1997; Adesoji, 2008 and Adodo & Gbore, 2012) and many show dismal performance in it (Afuwape & Olatoye, 2004; Odetoyinbo, 2004). This, according to Afuwape and Olatoye (2004), has prevented

students from offering or performing well in the core science subjects at the Senior Secondary level. In view of this, studies like those of Alebiosu, (2003), Ozaji (2008), Ogunkola and Olatoye, (2010), on students' performance in Basic Science Certificate Examinations reveal a disturbing phenomenon of poor performance. Ozaji (2008) reported that the analysis of Integrated Science (Basic Science) result of some state government controlled Junior Secondary Schools in Jos North Local Government area of Plateau state; Nigeria from 2003 to 2007 reveal a trend of underperformance. Similarly, Kano state students' performance in Basic Science in the last five available years as revealed in Table 1 reflects poor performance.

Table 1.1: Performance of Kano State Students in Basic Science (2008 – 2014)

Year	Total population	Credit Pass	% Pass	Number Fail	% Fail
2008	68401	19822	33.25	68401	66.75
2009	67835	22392	38.90	67835	61.10
2010	87112	32312	40.62	87112	59.38
2011	80182	28937	36.09	51245	63.91
2012	84392	26163	31.00	58229	69.00
2013	91392	36162	39.60	55200	60.40
2014	89979	30598	34.01	59381	65.99

Source: Kano Education Resource Center (2015)

Several reasons have been advanced by researchers on the persistent poor performance in Basic Science. Ozaji (2008); identified such factors responsible to (among others) include the followings: learners inability to interact directly with learning materials; wrong perception of science by the learners; and, fundamentally, the instructional strategy employed by teachers. Okoli (2006) observed that the persistent poor performance leaves one in doubt of the effectiveness of the teaching methods employed by science teachers. Similarly, Wudil (2013) explained that poor

performance among science students was because teachers of science employ the traditional (lecture or expository) method with little or no attention to the procedures that make students have good learning and understanding of basic concepts and principles. The traditional teaching (lecture) method is said to have such shortcomings because it only appeals to the learners auditory sense (Paris, 2014). Thus, learners who are weak in cognition especially children at the basic level, that are classified to be at 'concrete operational stage' learn by doing (activity) rather than by mere listening. Such students when taught with lecture method learn little or will not acquire the desired skills; hence, they would resort to rote learning. Okeye & Okeke (2007) supporting this position, observed that when students fail to understand concepts, they shy away from the questions arising from such concepts thereby leading to poor performance. Hence, Ogwuoda (2008) stressed that there is the need for better instructional strategies to be used to ensure effective and meaningful learning by the students. Tanner and Allen (2005) suggested that such strategies should access and activate the students' prior knowledge. This is because students fail to learn and understand science concepts not because they have no ability or interest, but because they find themselves presented with bits of knowledge or information out of their world experiences.

Bransford, Brown and Cocking (2000) and Ogwuoda (2008) stressed that students come to the formal classroom with a range of previous knowledge, skills, and beliefs that influence their thought and perceptions of the environment which affect their abilities to remember, reason, and acquire new knowledge. Since new knowledge cannot be built effectively on a weak foundation, it is of paramount importance for the teacher to explore the students' prior knowledge so as to have a better approach to presenting the new knowledge he/she wants the learners to imbibe.

Consequently, considering the objectives of Basic Science curriculum, it is advocated that its teaching employs the use of local examples and practices to enhance conceptual understanding (NCCE, 2012). However, UNESCO (2006) observed that this vital curricular provision has been neglected, and instructional processes in Nigerian classrooms are devoid of relevant practices from around the learner and are full of foreign examples, methods and ideas. Similarly Jegede, Lagoke and Oyebanji, (1999) observed that learners in Africa hardly understand science because, what is learned in science classroom does not often relate to their day-to-day experiences. With this, students shy away from science and the few that survive the rigors cannot form any relationship between what they learnt in the classroom and what they encounter daily (Farombi, 1997). Okebukola (1997) sharing this view, lamented that science instructions are presented in such ways that portray science as generally, an affair of the 'Whiteman'. Aikenhead (2002) studied the reasons for the under representation of Canadian Aboriginal people in careers related to sciences. He found that it was due to the 'western' manner in which science is presented to the learners. Similarly, Aikenhead and Jegede (2002) observed that in developing countries, students have the feeling that school science is 'foreign'. This feeling stems from the fundamental differences between the culture of western science and the students' indigenous culture. This situation, Aikenhead (2002) concluded, imposes some sort of cognitive imperialism which gets students 'assimilated into thinking that science is 'western'. This undermines students' identities which are fundamentally essential to scientific literacy.

In Nigeria, the cognitive imperialism has fostered a significant negative effect, as only a little percentage of the students aspire to study science (Arowolo, 2010). Even the so called few find it difficult to link what they learnt in school with what

they encounter in the society (Mari & Peni, 2010). However, Obidi (2005), discussing the nature of education in Africa, he observed that this difficulty was not due to the western nature of knowledge in general or science knowledge in particular. But it was because African education was predominantly consumptive rather than productive. 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 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. Despite this situation, Shumba In Peni (2008) observed that education occurs against the background of the cultural views and values of a particular society and all learners have rich sources of prior knowledge accumulated through various experiences that they get while interacting with their environment. He therefore opined that such experiences and cultural values should be used in the teaching and learning of science. The use of such cultural views would challenge the learners to explore their environment the more, make them ask questions about certain belief as well as bridge the gap between the culture of the students' home background and that of western science thereby de-westernizing science (Jegede, Lagoke and Oyebanji, 1999; Muhammad, 2013) and encourage cognitive function among the students. Muhammad (2013) stressed that when western science is contextualized within indigenous cultural practices in Africa, learning outcomes will be greatly improved. Such indigenous or cultural practices that have scientific relevance are referred to by experts in science education (Snow, 1972; Augé, 1999; Rist & Dahdouh-Guebas, 2006) as ethnoscience.

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 (Augé, 1999; 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).

Snow (1972) reported that the integration of indigenous knowledge and ethnoscientific approaches into contemporary frameworks for instructions began around 1960 to 1965 with the works of Carl Hime, a supervising teacher for science and math at Many Farms High School, Many Farms, Arizona, United States of America. The emphasis in introducing Ethnoscience at Many Farms then, was on life and ecological-environmental aspect of science.

Culturally relevant science employs materials based on the culture and history of an ethnic group to illustrate scientific principles and the methodology of science already in the school's science curriculum. Many principles of native knowledge were scientific; therefore, using culturally relevant materials can enhance the scope of science taught (Hobson, 2014). This is why the Basic Science curriculum emphasizes the use of the child’s environment its instructional processes. Similarly, the Basic Science curriculum is organized on themes that are generally related to the learners environment (e.g. you and the environment, you and energy, etc.)

The basic reason for the use of ethnoscience materials and ideas in the classroom stems from the sensitivity that a people have a strong hold for their culture and religion. Though, it is a general belief that nonwestern cultures are either anti-

scientific or, at best, a-scientific. Concurrently, it is a common belief that the Western cultural heritage is particularly propitious to scientific development (Mathew & Smith, 2006). Most of the material available on the development of science as well as the science curriculum taught in school reflects this ethnocentric orientation (Augé, 1999). This situation enhances inferiorism as well as lowers students' performance in non-western countries (Muhammad, 2013). This ugly situation needs to be changed and students are to be made to view science as something that happens within and around them. Thus, this study explored the efficacy of the use of culturally relevant practices (ethnoscience) in science instructions with a view to making viable recommendations that would enhance students' academic performance.

Another major challenge facing science education is gender. Lagoke, Jegede and Oyebanji (1999) raised serious concerns about gross under representation of girls in science. Ogunsola-bandele, (2000) reported that female students perform comparably lower than male students because they under estimate their ability and believe boys to be more superior. Akanbi (2004) also observed that poor self-image and discrimination are among the factors that affect female participation in science. Hence, the under representation of female students in science and science related disciplines. Psychologists (Westen, 1995) have argued that the difference in female and male students' academic performance was due to the nature of their brain. (Westen, 1995) argued that female students perform higher in test of verbal fluency, perceptual speed and manual dexterity, while males perform better in mathematical ability and spatial processing. He concluded that the difference may not be particularly large and is not particularly based on innate differences between the brains of the male and female but due to exposure (experiences). Similarly, Linn and Kanazawa (2011) conducted a longitudinal study of sex differences in intelligence

among students of ages 7, 11 and 16. They concluded that there was no gender difference in intelligence at the early years of childhood. From the forgoing therefore, it could be concluded that the under achievement of female to male were not due to innate ability, rather to environment, to which instructional process is part of. Thus, Erinosho (2005) maintained that lack of female interest in science subjects was because they do not experience science through activity. Jenkins in Peni (2008) argued that girls' interest and performance are improved when science is related to their concerns through effective instructional methodologies.

Okebukola (1997) reported that several interventions are being carried out with the objectives of de-masculinizing and demystifying science; improving girls' confidence and self perception of their ability to do science; as well as implementing teaching strategies that actively involve girls in science. On this note, Peni (2007), Mari and Peni (2010) reported that instructional processes that involve the use of local examples are capable of enhancing girls' confidence and self-perception of their abilities. This conclusion arouse due to a finding that the use of instructional materials improvised locally enhanced female attitude and performance in volumetric analysis (Mari & Peni, 2010). Similarly, in a study assessing the pre-service teachers' ability to interpret Hausa cultural practices, Peni (2007), reported that both male and female students were weak in their ability to find relevant explanations to some cultural practices that have application of one scientific concept or another and which they were taught during their classroom instruction. Thus the need to have a good instructional strategy that could help male and female students see science as what happens around them and enable them explain the happenings around them in a scientific manner, thereby, satisfying one of the basic objectives of science teaching and learning.

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' behavior. 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 practicals 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 favorable or unfavorable 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 behavior. 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 effects of ethnoscience-enriched-instruction on students' attitude 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 exist (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 are in-conclusive. 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 Basic Science.

1.1.1 Theoretical Framework

This study is premised on Ausubel's (1968) theory of meaningful learning. Ausubel 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 subsumers 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.

1.2 Statement of the Problem

Basic Science plays vital role in Nigerian science education program as it prepares pupils at the Junior Secondary level for the study of core science subjects at

the Senior Secondary level which in turn brings about students' interest in science oriented courses especially at the tertiary institutions.

Despite government's efforts to encourage science teaching and learning among Nigerian students right from the Primary and Junior Secondary levels, the enrolment of students in core science subjects and science oriented courses at the Senior Secondary School level and tertiary institutions, is not encouraging. This has made the attainment of the 60:40 admission policy in favor of the science-oriented programs a mirage; and the goal of Nigeria to be one the great and dynamic economies (FRN, 2013) difficult.

As important as Basic Science is, the persistent failures of the Nigerian Students in it (Sanni and Ochepa, 2002; Uloko and Imoko, 2007; Abakpa and Agbo - Egwu, 2008) has remained a major threat to its learning.

Attempts to find solution to this incessant failure have made researchers in science education to consider a number of factors. One of such factors which is re-examined in this study is the inappropriate method of teaching. Aworanti (1991) observed that researches on the teaching of Integrated Science revealed that teachers lecture and give notes in their lessons. This, he conclude, has serious implications for cognitive performance in the subject. Similarly, Odetoyinbo (2004) stressed that the method of teaching Basic Science in Nigeria 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 Nigerian 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 in Nigeria today.

Attempts to address this problem prompted several students researches, international and local symposia and conferences by public institutions and non-governmental organizations. Such symposia were organized at the Kongo conference hotel Zaria in November 1983 on the 'cultural implications of science education (Shu'aibu, 1983). Similarly, the Science Teachers Association of Nigeria has at different times floated conferences that address culturally related practices and materials in science teaching. Yet, the UNESCO (2006) observation reveals that these efforts (perhaps) end in papers and there are no empirical evidences to the effectiveness of the use of culturally relevant materials and practices in the instructional processes. This seems to call for the option of giving ethnoscience-enriched-instruction instruction a trial; being a teaching approach, which focuses on students' background, their cultural setting and practices as well as their immediate environments. Therefore, this work intends to assess the impact of ethnoscience-enriched-instruction on students' attitude, retention and academic performance, Basic Science among students in Kano state.

1.3 Objectives of the Study

The purpose of this study was to determine the impact of use of culturally relevant practices (ethnoscience-enriched-instruction) in the teaching of Basic Science concepts. Specifically, the objectives of the study were to:

1. determine the impact of ethnoscience-enriched-instruction on academic performance of JS II Basic Science students in urban and rural schools in kano state;
2. investigate the impact of ethnoscience-enriched-instruction on academic performance of male and female students;

3. determine the impact of ethnoscience-enriched-instruction on the retention of Basic Science concepts among male and female students;
4. determine the impact of ethnoscience-enriched-instruction on retention Basic Science concepts among urban and rural students;
5. Determine the impact of ethnoscience-enriched-instruction on male and female students' attitude to Basic Science.
6. Determine the impact of ethnoscience-enriched-instruction on urban and rural students' attitude to Basic Science.

1.4 Research Questions

The following research questions are formulated to guide the study:

1. What is the difference between the academic performance mean scores of urban and rural Basic Science students' taught using ethnoscience-enriched-instruction and those taught using lecture method?
2. What is the difference between the academic performance mean scores of JS II male and female Basic Science students taught using ethnoscience-enriched-instruction and those taught using lecture method?
3. What is the difference in the retention mean scores of Basic Science concepts between urban and rural students taught using ethnoscience-enriched-instruction and those taught using lecture method?
4. What is the difference in retention mean scores of Basic Science concepts between male and female students taught using ethnoscience-enriched-instruction?
5. What is the difference in the mean attitude ranks among urban and rural students taught Basic Science concepts using ethnoscience-enriched-instruction and those taught using lecture method?

6. What is the difference in mean attitude score of male and female students taught Basic Science concepts using ethnoscience-enriched-instruction?

1.5 Hypotheses

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

Ho_1 There is no significant difference between the academic performance mean scores of urban and rural Basic Science students' taught using ethnoscience-enriched-instruction and those taught using lecture method;

Ho_2 There is no significant difference between the academic performance mean scores of JS II male and female Basic Science students taught using ethnoscience-enriched-instruction and those taught using lecture method;

Ho_3 There is no significant difference in the retention of Basic Science concepts between urban and rural students taught using ethnoscience-enriched-instruction and those taught using lecture method;

Ho_4 There is no significant difference in retention of Basic Science concepts between male and female students taught using ethnoscience-enriched-instruction;

Ho_5 There is no significant difference in the mean attitude ranks among urban and rural students taught Basic Science concepts using ethnoscience-enriched-instruction and those taught using lecture method;

Ho_6 There is no significant difference between the mean attitude ranks of male and female students taught Basic Science concepts using ethnoscience-enriched-instruction;

1.6 Significance of the Study

Today, the world has widely accepted the relevance of science as the bedrock to scientific, technological and economic development of all nations. This appreciation prompted nations to introduce the teaching of science (as Basic Science) to students right from their formative age to enable them appreciate science and develop positive attitude towards it. However, the trend in the performance of students in science has been worrisome and calls for effective instructional processes that will enhance learner participation and performance. This study employed ethnoscience-enriched-instruction to teach Basic Science students. The findings of this study will hopefully uplift the standard of Basic Science in particular and science education in general in the following ways:

1. Being ethnoscience-enriched-instruction a novel approach in science teaching, the study provided empirical evidences for the effectiveness of the approach in instructions so as to provide a basis for its implementation and use by educators (teachers), researchers and policy formulators;
2. Culturally relevant practices that have scientific basis are numerous and diverse. There is need for teachers to explore them and use them in communicating science. This study provided teachers with the basic knowledge of how they can explore and use culturally relevant practices (ethnoscience) in teaching science concepts.
3. The findings of this study provided a guide curriculum planners to understand the impact of ethnoscience-enriched-instruction and provide a basis at which they could enforce its use in teaching.
4. It has been established that science books used in our schools contains illustrations that are highly Eurocentric. This makes students to see science as

an activity of the white. With this, there is the need to have books that contains illustrations obtained locally. Thus, the study provides book writers and publishers the opportunity/evidence of using the culturally relevant practices as illustrations and exercises in their books.

5. Researchers will have relevant and current literatures for similar researches as well as provide foundation for further research.

1.7 Scope of the Study

This study examined the effects of ethnoscience-enriched-instruction on attitude, retention and academic performance among Basic Science students in Kano state. The JS II students were be used because they are the most stable set at the upper basic level. This is because the JS I students were newly admitted; while the JS III students were getting ready for their Basic Education Certificate Examinations (BECE). Similarly, the topics for this study include: density, forces, pressure, catalysis, acids and bases, and simple separation techniques, exchange of materials between cells. The topics are selected because they fall within the contents to be taught to students at the particular level (JS II). The topics also form important introductory aspect to the aspects of man and energy, and nature of matter that are part of the six themes of Basic Science. Some of the topics like forces, pressure, and density involve simple calculations which make learners to perceive them to be difficult. The selected topics falls part of those perceived to be difficult to both teachers and students (Ogunkola & Samuel, 2011).

The study was limited to schools under the Bichi Zonal Education Area (ZEA) office Kano state. Bichi ZEA is one of the 11 ZEAs in Kano state. It takes care of 73 secondary schools (Junior and Senior Secondary schools) in the 4 local government

areas under the zone. The local governments include Bagwai, Bichi, Kunchi and Tsanyawa. All the three local governments (except Bichi) are termed educationally disadvantaged in Kano state (Gidan Malamai, 2008; 2009).

The study considered the impact of school and child location on academic performance and attitude to Basic Science among students. The students were grouped into urban and rural locations. The study employed two instruments for data collection. The Basic Science Performance test (BSPT); and, The Students Attitude to Basic Science Questionnaire (SABSQ).

The study was also limited to the selected topics. The topics include: acids and bases, forces, density, digestive system, kinetic theory of matter, separation techniques and sounds. The topics are mainly from the year 2 content of the Basic Science curriculum.

1.8 Basic Assumptions

This study was based on the following 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 Basic 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.
v. The students can read, comprehend and answer the items in the Basic Science Performance test and the Students Attitude to Basic Science Questionnaire (SABSQ).

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

This study investigated the impact of Ethnoscience-enriched-instruction on attitude, retention and academic performance in Basic Science among urban and rural students in Kano state, Nigeria. In this chapter, relevant literatures to the study are presented in the following subheadings:

2.2 Teaching of Basic Science;

2.3 Contemporary Teaching Strategies in Basic Science;

2.4 Science and Culture;

2.4.1 Ethnoscience and Science Teaching and Learning;

2.5 Students' Location (Urban & Rural) and Academic Performance;

2.6 Gender and Academic Performance,

2.7 Instructional Strategy and Students' Retention of Learnt Concepts;

2.8 Students' Attitude and Performance in Basic Science;

2.9 Overview of Similar Studies;

2.10 Implications of the Literature Reviewed for Present Study.

2.2 Teaching of Basic Science

Science has been defined as a human endeavor 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 (FRN, 2013). For this, Fafunwa in Peni (2001) vividly captured the position of science in every society when he says "we are living in a world where science and technology have become an integral part of the world's culture and any country that overlooks this significant truism, does so at its own peril".

Conventionally, the principles of science are usually employed in everyday activity among all communities (Obidi, 2005). These principles are inform 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 'bankrupsy' among Africans. The need to change this situation prompted the inclusion of science into the school curriculum.

The history of science teaching in Nigeria dated back to 1867. It was introduced as Nature Study and Hygiene. Later, it metamorphosed into Biology, Chemistry and Physics. Consequently, the Science Teachers' Association of Nigeria in 1970 muted the idea of the Nigeria Integrated Science Project (NISP); a step towards presenting science to the child, reflecting the culture and tradition of Nigerians. Oludipe (2012) quoting the Federal Ministry of Education (1981) observed that the principal reasons why the Nigerian government started the Basic/Integrated Science Project were to:

(1) provide students with sound basis for continuing education;

(2) enhance the scientific literacy of the citizenry;

(3) enable students to understand their environment in its totality rather than in fragments;

(4) enable students to have general view of the world of science;

(5) as the processes of science serve as unifying factor for the various science subjects, it is necessary for the learners to know these processes through integrated approach of learning science.

In 1999, the Federal Government of Nigeria, under the Obasanjo Administration Launched the Universal Basic Education (UBE) in Zamfara State (Daudu, 2000). It was legalized by the Compulsory Free Universal Basic Education Act of 2004. UBE derives it justification from the 1999 constitution of the Federal Republic of Nigeria 5.18 (1) which says that;' government shall direct its policy towards ensuring that there are equal and adequate educational opportunities at all levels'; and in Section 18 (3) of the constitution among other things says…' that government shall; as and when practicable provide: Free, compulsory and universal primary education, Free secondary education.'

The UBE as a reform programme in the 6-3-3-4 system of education among other things lays emphasis on curriculum review to make it relevant to National development in line with the global and national demand of this era (Dung and Udofia, 2010). Such curricula review they argued, should meet the diverse needs of all citizens. Thus the curricular materials were restructured and Basic Science replaced Integrated Science in 2008 (Igwokwe, 2015).

Dung and Udofia (2010) observed that one of the cardinal precautions in the production of the Basic Science curriculum was to ensure continuity, in relevant themes of the Basic Science that should be maintained in the curriculum. Basic Science is science presented to the child such that, the child gains; the concept of the fundamental unity of science, the commonality of approach to problem of a scientific nature and an understanding of the role and function of science in everyday life, as

well as the world in which he/she lives (NCCE, 2012). Basic Science involves the basic training in scientific skills requirement for human survival, sustainable development and societal transformation (Dung & Udofia, 2010). Thus the themes of Basic Science reflect the relationship of the learner with component concepts to be learnt and his environment. For example:

'You and Technology'. This was designed to, exposed students to developing science and technological skills which will assist them make informed decisions, develop survival strategies and learn to contribute and live qualitatively in the global community (Dung & Udofia, 2010).

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 him.

So far, the attainment of the above curricular objective is still far from reality. This is because several studies have criticized the quality standard of science education in Nigeria. That students underachieve in the science subjects has been variously documented (Olatoye, 2002; Mbela, Gamdo & Ibrahim, 2010). Ogunkola and Olatoye (2010) observed that report from the Second International Study of Science Performance (SISSA) shows that Nigeria is one of the few countries that performed below average on the science performance test. Baikie (2011) observed that the quality and standard of education in Nigeria has been undergoing spates of criticism for its poor quality. This is evident in the poor performances in the school certificate examinations like WAEC, NECO, NABTEB and JAMB as well as the ineffectiveness on job performance. This poor performance is attributed to the poor

instructional procedure employed by teachers (Bimbola & Oludipe, 2010) in their instructional processes. Similarly, Olanrewaju, (1999), Afuwape (2011), Afuwape and Olatoye (2004) Odetoyinbo (2004), Bilesanmi-Aweduru and Oludipe (2012) etc. observed that many students show dismal performance in Basic Science, and are not benefiting much from the Basic Science curriculum. This, according to Afuwape and Olatoye (2004), Bilesanmi-Aweduru and Oludipe (2012) has prevented many students from offering core science subjects or performing better in the core science subjects at the Senior Secondary School level. Thus, the policy proposal which stress that emphasis shall be given to education in Science and technology related disciplines at the ordinary level of school system to enable the attainment of a 60:40 admission ratio for science and humanities (respectively) into the tertiary education (FRN, 2013) is still a mirage! This situation calls for alternate instructional approach to enhance learner interest and performance in Basic Science. One of such approaches that have been emphasized by scholars is that which involves the use of the childs' immediate environment. Hence, this study assesses the impact of ethnoscience-enriched-instructional strategy (a strategy that involves the child culture) on students' academic performance and attitude to Basic Science concepts.

2.3 Contemporary Teaching Strategies in Basic 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-centered 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 Nigerian classrooms are discussed as follows**.**

Lecture method, otherwise known as expository, teacher centered 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. Effectiveness 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 behavior 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 draw backs of lecture methods are enumerated thus:

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.

Several 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 favor 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 favor 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 performance (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 inferiorism, 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 Nigerian 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 Nigerian 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–posttest 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 this inferiorism 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'.(pp22)

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 becomes greatly improved. He further defended his argument by citing Cobern (1996) who contends that:

> It is important for science educators to understand the fundamental, culturally based beliefs about the world that students bring to the class, and how these beliefs are supported by student's cultures, because science education is successful only to the extent that science can find a niche in the cognitive and socio-cultural milieu of students (pp 93).

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 co-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 Nigerians 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.

2.4 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 molded 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 has 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. Adenyi (1987) in Igbokwe (2010) for instance has observed that in Africa in general and Nigeria in particular 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 Nigerian 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.

2.4.1 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).

The Nigerian-UNESCO special Science improvement project' national coordinator Dr Boubaca Camara presented a paper on improving Basic Science titled: "a paradigm shift from active to effective learning. In the paper he observed that a lesson can be active but not effective. He asserted that teachers should facilitate the integration of life experiences and life values into their lessons. He elucidated a fundamental relationship linking education, culture and development through an equation. The equation is:

$$D = (E)(C)$$

Where D = development

E = education

C = culture

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 Nigeria 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 (UNESCO-ACEID, 1997) 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." (UNESCO-ACEID, 1997)
- Equality: "... there are also other population groups who, by virtue of language, ethnicity, geographical location, or economic status, are underserved by education systems." (UNESCO-ACEID, 1997)

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 knowledges (i.e. knowledges 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 superiorism 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 life-world 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.

2.4.2 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.

2.4.2.1 Collateral Learning and Science Teaching

Collateral learning theory as proposed by Jegede in 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 in 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.

2.4.2.2 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 the 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 in 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:

1. 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;
2. 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;
3. 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.

2.4.3 Hausa and Hausa Cultural Practices of Ethnoscientific Relevance

Hausa is a language spoken by about 50 million people of West Africa. Its speakers cut across West African countries like Nigeria, Ghana, Benin Republic, Togo, Cameroon, Mali, Niger, etc. The tribe has a wide range of cultural heritage of scientific relevance. The following are some of the practices that could be used to explain certain scientific concepts.

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



Plate 2.1: Black Smith Heating a Metal



Plate 2.2: Black Smith Shaping a Heated Metal



Plate 2.3: A Girl Carrying Calabash Freely on Her Head.



Plate 4: Butcher Inflates an Animal

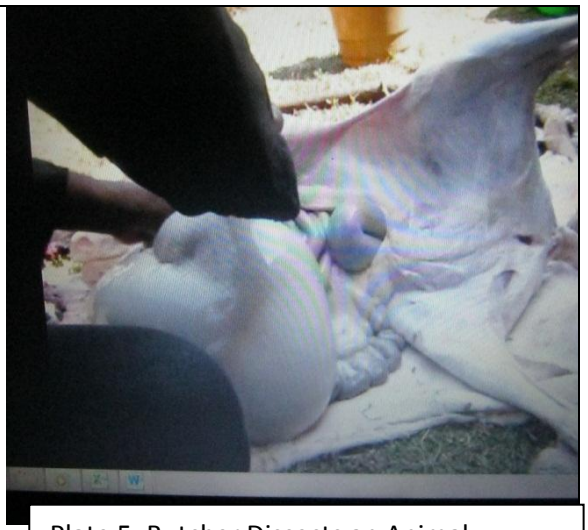


Plate 5: Butcher Dissects an Animal

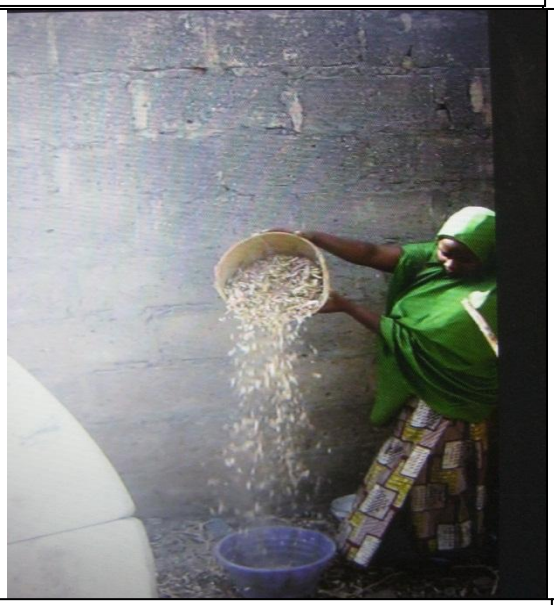


Plate 6: A Woman Winnowing to Separate Grains from chaff



Plate 7: Another Form of Winnowing

Other practices that are of scientific relevance include:

Table 2.1: List of Hausa 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
Slicing of meat to enhance faster drying for *kilishi* making	Increase in surface area
Soap making	Saponification
Addition of ash into pit latrine	Neutralization reaction

2.5 Students' Location and Academic Performance in 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 centers (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" settlements, 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 environment 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 centers. This definition underscores that rural areas are mainly agrarian while the urban areas are industrial. Oyeleye (2001) stressed that rural areas has less population than urban centers; 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 centers (Oyeleye, 2001). The Trading Economics (2015) based on World Bank Indicators in Nigeria reported that the population of

Nigeria 158,423,18 of which the urban population was 50.20% (79,528,437.40) and rural population 49.8% (78894744.60).

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 childs 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, Daramola cited in 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.

Adeyemi (2011) analysed the relationship between students' academic performance and their school locations in Ondo and Ekiti states. He found a significant relationship between school location and students performance; i.e. students in rural schools under perform relative to those in the urban schools. However, this conclusion is premised on the study in which the samples so selected were of those students in the urban and rural schools with grades of A, B, and Cs only. The study ignored the students' scores and considering all to have a credit pass in Basic Science, took the frequencies of the students. The frequencies of credit pass may be deficient at providing a good picture of students' performances; this is because more students at the rural or urban schools may have higher scores than the other. This is because grades are ordinal scores and the means scores and deviations were not involved in the analysis. Also Uju (2006) assessed the combined effects of game strategy and location as Factors of Academic Performance in Igbo grammar. The result reveals that students from the urban schools achieved higher than their rural counterparts. It therefore confirms that students in urban located schools

achieved statistically higher in Igbo grammar than their counterparts in rural located schools.

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.

2.6 Gender and Learning of Science

The current world trend and research emphasis on gender issues followed the millennium declaration of September 2000 (United Nations, 2000) which has as its goal, the promotion of gender equity, the empowerment of women and the elimination of gender inequality in basic and secondary education by 2005 and at all levels by 2015. For full realization of this laudable objective, the millennium declaration seeks that enrolment, retention and performance in school subjects should be evenly distributed across gender. Unfortunately, gender inequality in education has remained a perennial problem of global scope (Bordo, 2001).

Globally, the issue of gender inequality in Science, Technology and Mathematics Education (STME) has produced inconclusive results (Bassey, Joshua, & Asim, 2011). Many have decried the gender effects on academic performance and the disproportionately low participation of female students and minorities in science education programs and careers (Ogunsola-Bandele, 2000). This gave the male a greater dominance over their female counterparts. The under representation of women in science has led many feminists scholars to postulate that science as practiced in the world is "gendered" and used to the benefit of a 'male world' (Erinosho, 2005). In

Nigeria, male dominance over the feminine gender seems to be favored by the cultural environment. Cultural provision for male students makes them fit and able to cope with tasks requiring high intellectual and computation challenges (Akanbi, 2004). This phenomenon of sex-stereotyping is so pervasive that from birth, society fixes gender roles and conditions males to play and act within the confines of intellectually and physically more challenging tasks like construction, molding, football, palm-wine tapping, climbing, agriculture, fishing and the like. Women on the other hand, are 'sentenced' to the kitchen and related domestic chores, including child-rearing. With this, female students in schools tend to opt for subjects like, Home Economics and at most Biology (Bassey, Joshua, & Asim, 2011). Ogunsola-Bandele (2000) reported that male and female adolescent students follow a traditional gender stereotype. Males prefer mathematics and science while the females opt for reading and if science, life science (Ogunsola-Bandele, 2000; Akanbi, 2004). Similarly, most girls do under estimate their academic ability and believe boys to be more superior and therefore more capable of handling difficult subjects like sciences and mathematics (Ogunsola-Bandele, 2000). Boys themselves perpetuate this myth by exhibiting a 'macho' behavior around the school (Akanbi, 2004), for example, laying claim to and dominating most of what they consider to be 'masculine' such as computer rooms, science laboratories, etc. some even openly ridicule the girls who dare to venture into what they consider 'masculine subjects' (Ogunsola-Bandele, 2000).

Some gender-based science researchers have reported that, what both the 'feminist empiricists' and the 'liberal feminist critics' seem to agree on, is that females in principle will produce exactly the same scientific knowledge as males provided that sufficient rigor is undertaken in scientific inquiry (Howes, 2002; Foley and Mcphee, 2008). Howes, (2002) also believed that females and males are equal in

their approach to science, and that inequality in science and science education is caused by such factors external to science, like gender roles and teachers quality of instruction. Thus teachers will be expected to focus on removing these external obstacles through appropriate instructional strategy like ethno science.

The influence of gender on students' performance in Science has for a long time been a concern to many researchers and science educators. Many of them sought to determine whether it is true that there is male superiority in science performance or not (Adesoji & Babatunde, 2005). The results obtained are varied. For instance, Offorma (2009) studied the nature of performance among male and female pupils in Basic Science, mathematics, English and Social Studies in Nigeria. The performance of the two groups however, is poor from the mean scores. But state wise comparison of the pupils performance based on gender reveals that the male dominated the higher performance especially in Basic Science where they have the highest mean scores (46.88) in 25 States. Similarly, Bello and Abimbola (2011) assessed the influence of biology students' gender on ability to construct concept-maps on evolution. Findings from this study revealed that concept-mapping ability is not significantly influenced by students' gender. This is because, ability to construct properly integrated and complex concept maps (good concept map) was observed among both male and female students. However, the percentage of' male students that constructed good concept maps was slightly higher than their female counterparts.

Scholars have argued that female students do not like practicals (Scott in Bichi, 2002). This made Bichi to conclude that female students cannot do well in inquiry instructional class. But Erinosho (2005) countered that the lack of female interest as well as low performance in science was because they do not experience science. She concluded that girls' interest increases when science instructions are

related to their concerns. With this assertion, Mari and Peni (2010) reported that female students exposed to instructions with improvised materials performed equally well compared to male students exposed to standard instructional materials. They attributed the findings to the fact that the improvised instructional materials were sourced locally and presents more familiar situation to the female students than the male. This therefore agrees with Akanbi, (2004), Ogunsola-Bandele (2000) that when instructional processes are related to girls concern, they perform equally good as their male counterparts. Thus with the female population of about 49% of 162.5 million people (United Nations, 2013) there is the need for a good approach to instructions to enhance their science literacy. Hence, in this study innovative instructional strategy (ethnoscience) will be employed on students to see whether or not it will enhance their academic performance and retention in Basic Science at the Junior Secondary School level.

2.7 Instructional Strategy and Students' Retention Ability

Permanent and meaningful learning are ultimate target of every educational endeavor (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 knows.

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 posttest scores in favor 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 Centered 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-posttest. 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. Thus, 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.

2.8 Students' Attitude and Academic Performance in Science

Sola & Ojo (2007) and Akinbobola & Ikitde (2008) defined attitude as beliefs and opinions that can predispose individual to behave in certain ways. Thompson in Peni (2008) and Foley & Mcphee (2008) sees attitude as opinion or way of thinking, or the behavior 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 behaviors and have implications for learning as observed by Kay in Muhammad (2011). Attitudes are significant predictors of effective learning Akinbobola & 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 was 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. Adesoji (2008) laments that in general, the attitudes of Nigerian students towards the Basic Sciences tend to decrease in the order, Biology, Chemistry, Physics and Mathematics.

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 & 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 Nigerian societies, science is seen as a males activity and a '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 labor, 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 behavior are among the factors that make the girl child to shy away or perform poorly in school science (Ogunsola-Bandele, 2000; Forum for African Women Educationist (FAWE) 2000). Another factor as observed by Ogunsola-Bandele 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 endeavors.

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.

2.9 Over View of Similar Studies.

Quality science teaching has been the concern of governments, teachers, curriculum developers and societies the world over. This is due to the tremendous importance of the subject in a nations' technological and economic development. Thus governments evolved policies to entrench the learning and teaching of science at all levels of education. Despite these attempts, the level of science teaching in

underdeveloped and developing nations (within which Nigeria falls) has been discouraging. This situation has been attributed to the nature of instruction that is devoid of the child/learner's background. Thus several studies were conducted by researchers to identify the efficacy of instructions involving the learners' home environment.

The use of learners' local practices and environment in teaching and learning has been given several names by scholars like Aikenhead (2002), Fakudze (2004) and Rist and Dahdouh-Guebas (2006) as Indigenous knowledge, Snow in Michie, (2001) as ethnoscience. The appreciation of the relevance of ethnoscience in science teaching began with the work of Snow in 1974. Since then, several works have been done to encourage learners from minority (disadvantaged groups: usually nonwestern societies) to cope with what is today identified as 'western science'. Even though lots of arguments have been put forward to the effect that the context of the science is not really western as all cultures have elements of science, Aikenhead and Huntley (2004) observed that there is the need to appreciate that science teaching in the present content and contexts conveys a particular Eurocentric worldview due to the fact that science is a subculture of Western (Euro-American) culture. Thus, the world view differences that arise due to the childs' local environment and that of western science, affects students enrolment and performance in science and hence the reason for low enrolment in science and science related jobs among African and Aboriginal students (Aikenhead and Huntley, 2004). This understanding of the way nonwestern learners acquire science made science educators like Aikenhead, Jegede, Fakudze, Rist, Dahdouh-Guebas etc. to venture into several studies of how to improve the status quo especially in the Canadian Aboriginal and some south African schools. Consequently,

their studies (Aikenhead, Jegede, Oguniyi) in Fakudze (2004) lead to the development of learning theories and hypothesis. These theories are:

i. Border Crossing theory (Aikenhead, 1996).

ii. Collateral Learning Theory (Jegede, 1995).

iii. Contiguity Learning Hypothesis (Ogunniyi, 2002).

These theories considered the nature of the learner relative to his home environment and made case that teachers should use relevant examples, practices, knowledge as well as principles that are related to learners' environment to demystify science.

Veal (2001) after a study of the reasons for unpopularity of science in Africa observed that the science taught to students provides education that is not applicable to local needs and it channels the labor forces towards a narrower, rather than wider, range of occupational opportunities. Thus, such poor skills acquired by learners, he opined, are applicable only for the absorption of transferred technology, rather than for local innovation. He therefore concluded that Africa must find efficient and convenient approach to developing and transmitting its existing scientific knowledge as well as reduce dependency on western science. This, he suggests, could be achieved through the use of local resources and/or indigenous knowledge.

Thus in furtherance to the above, in Nigeria, the use of indigenous knowledge in science instruction was made through the use of mother tongue and use of improvised instructional materials (Abonyi, 2002). The first attempt (so documented) to indigenize science instruction in Nigeria was through *'Sayensi'* the Ife primary Education Research project 1970 - 1978. This project was conceived and executed on the use of the mother tongue to teach science to students at the primary school level.

According to Fafunwa, Macauley and Sokoya (1990), the project was conceived based on the perception of the underdevelopment of the state which was largely due to the use of English as a language of instruction at the primary school. They stressed that the psychologist asserted that the first to twelve years of the child are the most formative in the Childs' education. The results of the research project revealed that the mother tongue is a virile tool for education. The project therefore recommended for its experimentation in other parts of the country. Alas, this implementation could not see the light of the day due to socio-political situation of the country.

The success of the above study suggests that no culture is a-scientific and other cultures can be explored in their use to enhance science literacy. However, the study is limited to use of Yoruba language as a medium of instruction. Since language is the major vehicle upon which cultures are driven; certainly there will be some culturally relevant examples that were used in the study. This culturally relevant example forms the core to ethnoscientific study. This therefore poses some limitations to the findings the study and suggests that similar studies be conducted in other tribes and cultures to ascertain the efficacy of the instructional process and enable wider generalization. Similarly, the programme ended with only primary school pupils and did not continue at the junior secondary or middle basic level. Therefore there is the need for the use of higher level students so as to find out the possible impacts. Hence, the need to employ ethnoscience-enriched-instruction in the teaching of Basic Science.

Mari and Peni (2010) studied the effect of improvised instructional materials on male and female students' academic performance and attitude to volumetric analysis. The study employed a pretest-posttest experimental control group design. 103 Senior Secondary I (SS I) students (38 females and 65 males) from four non

coeducational (2 males and 2 female) schools formed the sample for the study. The Students Chemistry Performance Test (SCAT) and the Students Attitude Inventory (SAI) were the instruments used for data collection. The treatment package for the experimental group involved the use of improvised and/or locally available materials while the control group was taught with standard instructional materials. The findings revealed that there was no difference in the academic performance of male and female students in the concept. However, the female mean was persistently observed to be higher than that of the male. They attributed the difference to be due to the local/domestic nature of the improvised materials which are more familiar to the girls than the boys. Thus instructional materials obtained from the child's home environment is capable of enhancing the learners interest especially girls.

However, although the topic they taught was in the senior secondary curriculum, same topics are taught at the upper basic (junior secondary level). Its introduction at the upper basic level is to prepare learners for future exposure into science. Hence the need to create a formidable background for the students' success. Similarly, the study was limited to a single topic in Basic Science/chemistry (acids and bases). There is therefore the need to widen the scope of the study to enable wider generalization.

Muhammad (2013) observed the need for the inclusion of multi-cultural approach to the teaching of science. He observed that science teaching in Nigeria and other African countries is being challenged by the conflict between school and traditional society reflected in conceptual and instructional models; an interplay of psychological and socio cultural variables in the teaching and learning of science as well as a disjunction between science learned in school and what goes on in the lives of individual in the society. He further argued that this undue reliance in school

science (western science), leads to regurgitation of facts and eventually rote memorization.

To curtail these situations and contribute to the improvement of science and science literacy in Nigeria in particular and Africa in general, he ventured into the assessment of the effects of multicultural teaching approach to students concepts formation in biology. The study employed a quasi-experimental design, using a population of senior secondary II students in Kano state. The findings of the research revealed a significant effect of the multicultural approach to students' concept formation in biology. It also revealed that there is no gender disparity in terms of concept formation, when students are taught biological concepts using multicultural strategy.

The findings of the above study are not far from the ones discussed earlier. This is because the study is limited to Biology and employed senior secondary school students. It is therefore required that studies relative to students home environment be conducted in Basic Science.

Usman (2011) conducted a correlational study on the relationship between cultural beliefs on scientific development in Nigeria by investigating the relationship between students' cultural beliefs and students understanding of Biology concepts. The study employed a correlational research design with 100 subjects sampled from two coeducational schools from Sabon Gari local government area of Kaduna state. The study however did not describe the treatment procedure, it is premised that the study was based on a survey design. The study found a significant relationship between the student's cultures and their cultural beliefs. The study however reported a negative relationship in girls' performance with their cultural belief. He therefore

concluded that some cultural beliefs need to be explained to the students in a scientific way to 'probably' reduce the hindrance of the beliefs in the learning of biology. To explain this therefore requires a culturally enriched instructional procedure. Hence the need for ethnoscientific approaches in the teaching and learning of science.

Achor, Imoko and Uloko (2009) studied the effect of ethnomathematics teaching approach on senior secondary students' performance and retention in locus. Ethnomathematics teaching approach as used in their study involved taking the students out of class to practically undertake some culturally loaded activities like house roofing and farm layout. Specifically, they emphasized, students were made to roof houses, lay out some farms and in the process take measurements to be further used in calculation. Since the focus is Locus, emphasis was on straight line, circle/ellipse, trajectories and parabolic shapes.

The findings of the study showed that students taught with Ethnomathematics teaching approach had a higher mean performance score in Locus than their counterparts taught with conventional approach. They reasoned that the difference in the means between experimental and control group was because the experimental group students were able to integrate or link their background of study and their immediate environment with the foreign aspect of the learning of Locus. They also argued that because the teaching was done in a practical way, it provided a 'flow' from home to school and from school to one's trade and to everyday living. Thus the abstract nature of teaching and learning of mathematics seemed to have been reduced. D'Ambrosio (2001), Uloko and Imoko, 2007; Uloko and Ogwuche, 2007) also reported that failure in mathematics in Nigeria is due to the fact that the teaching and learning is purely foreign in nature and confirmed that ethnomathematical instructional strategy influence students' retention. With these findings Achor, Imoko

and Uloko (2009) concluded that performance and retention in Locus depended on the approach of instruction and recommended the use of ethnomathematics teaching approach in mathematics lessons.

The study conducted by Achor, Imoko and Uloko (2009) is related to the current study as it assessed the impact of ethnomathematics on students' academic performance and retention. It however differs as the area of study was in mathematics and the subjects used were those of the senior secondary school level. The study was also limited to the concept of locus of a circle. With this difference in the subject and the age of the learners, it is of paramount importance to duplicate the study in other subjects to confirm or dispute their findings.

The closest related study is that of Abonyi (2002) who observed that the use of ethnoscience in instructions has been hindered by a lot of speculation as to the existence of gulf between the culture of the learner and that of the modern science. He highlighted that it is widely believed that cultural knowledge has no relationship with advanced scientific knowledge and therefore unnecessary in science instruction. These speculations are however not backed by empirical evidence (Abonyi, 2002). This lack of evidence made Abonyi to venture into researches that will involve the use of the learners' cultural or local environment or practices in order to justify or falsify the claims.

Abonyi (2002) studied the effects of ethnoscience-based instructional package on students' attitude to science. The study was conducted in in six secondary schools of Ebony state. Three of the schools were assigned to experimental group while the remaining three were assigned to control group. A total of 124 subjects (51 males and 73 females) made up the sample for the study. The study was specifically geared towards answering the questions of whether ethnoscience instructional package has

effect on students' interest to science as well as their (students') gender. The experimental group was taught Basic Science using the ethnoscience-based instructional package while the control was taught using the lecture method. The instrument used was the Baggaley's Interest in Science Scale (ISC). The study concluded that ethnoscience instructional package is effective at improving students' attitude to science and is gender friendly. However, the study was conducted using senior secondary II students in Enugu state, using the Igbo ethno scientific concepts. Another limitation of the study is that it was only interested in students' attitude to science and not performance and academic retention of learnt concepts. Similarly, the instrument used was on a Likert's scale which generates ordinal (non parametric) data, but the study employed ANOVA (a parametric test) to test the hypothesis. With this therefore, it is worthy to replicate such research in a different environment so as to ascertain the efficacy of the ethnoscientific instructional strategy on students' performance, attitude and retention using appropriate statistics. The results of the study will not only validate the earlier findings but will also provide a wider scope of empirical literature to the effectiveness or otherwise of ethnoscience instructional strategy on students' performance, attitude and retention.

2.10 Implication of Literature Reviewed on the Present Study

The study began by appreciating the contributions of functional science literary among the populace to the societal, political and economic developments. These appreciations prompted the government of the Federal Republic of Nigeria to include science in the primary, secondary and tertiary education curricula. According to the National Policy on Education (FRN, 2013), the Nigerian government seriously support the teaching and learning of science not only at the higher level but also at the lower level of education with a view to:

a) Laying a sound bases for scientific and reflective thinking;

b) Giving the pupils the opportunity for developing manipulative skills;

c) Providing the pupils with the basic tools for further educational development;

d) Developing in the child the ability to adapt to changing environment.

However, since the adoption of the National Policy on Education as the guiding document to the development education in 1981, even the 60:40 Science & Technology to Humanities ratio has not been attained. The smaller number of students that enroll 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 learner's 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 ethno scientific 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

3.1 Introduction

This study investigates the impact of Ethnoscience-enriched-instruction on attitude, retention and academic performance of JS II students in urban and rural areas of Kano state. The chapter describes the methodology that was employed in carrying out the research. It is presented under the following subheadings.

3.2 Research Design

3.3 Population of the Study

3.4 Sample and Sampling Technique

3.5 Selection of Basic Science Concepts to be Taught

3.6 Instrumentation

3.7 Administration of Treatment

3.8 Data Collection Procedure

3.9 Procedure for Data Analysis

3.2 Research Design

This research adopted the quasi experimental design. It employed a Pretest posttest quasi-experimental control group design. The study involved experimental group that were taught Basic Science concepts using ethnoscience-enriched-instruction (Appendix A); and a control group taught Basic Science concepts with the lecture instructional method (Appendix B). Both the experimental and control groups consisted of male and female subjects from rural and urban schools. The groups were pretested (before the treatment) to ensure that they did not differ significantly in their academic performance before the treatment. Similarly, the groups' attitude to science was pretested to find out the attitude of the subjects towards science before the

treatment. A six weeks treatment was given to both experimental and control groups. At the end of the treatment, a posttest 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-posttest was administered to assess the extent of retention of the concepts learnt. The design of the study is illustrated in Figure 3.1

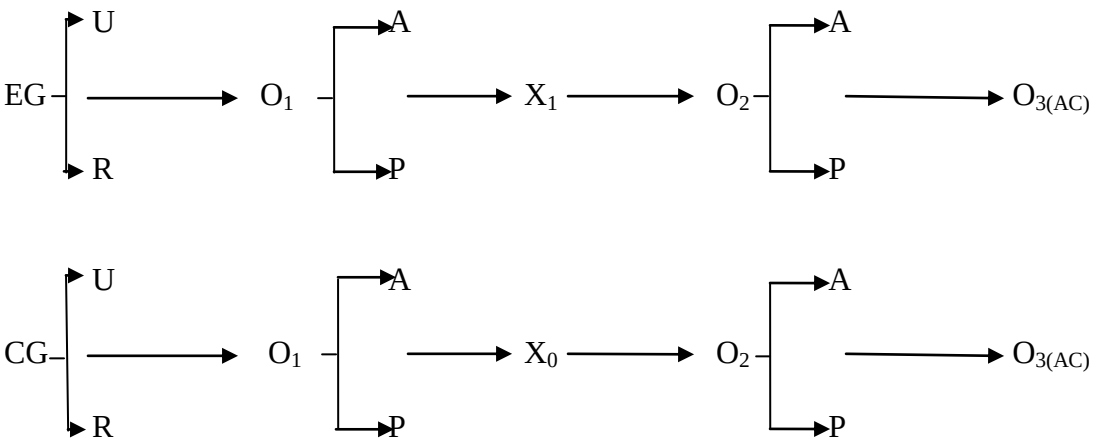


Figure 3.1: Schematic Research Design

Where:

EG	-	Experimental Group	X_0	-	Lecture Method
CG	-	Control Group	P	-	Performance
R	-	Rural	A	-	Attitude
U	-	Urban			
O_1	-	Pre-test			
O_2	-	Posttest			
O_3	-	Post posttest			
X_1	-	Ethnoscience-enriched-instruction			

3.3 Population of the Study

The population of the study comprised of all the 5,113 JS II students in the 73 Public Junior Secondary Schools under Bichi Zonal Education office, Kano State. The schools are mainly single sexed with the exception of three that the male and female schools share the same blocks but are under different administrations. The average age of the male students is 15 while that of the female is 14. The details of the schools and population are in Appendix C. the summary of the characteristics of the population is presented in Table 3.1.

Table 3.1: Population of the Study

	Schools (General)		Urban schools		Rural schools	
Gender	No	Population	No	Population	No	Population
Male	49	3104	6	860	43	2244
Female	24	2009	4	882	20	1127
Total	73	5113	10	1742	63	3371

Source: Kano State Secondary School Management Board Bichi Zonal Office (2014).

3.4 Sample and Sampling Technique

The study employed a two-stage stratified random sampling approach. The major strata of interest were students' gender (Male & Female), and geographical location (i.e. Urban & Rural schools). The first stage involved selecting schools for the study. To do this, the schools were classified into urban and rural schools. Thereafter, the rural schools were grouped into male and female schools. This was because coeducational schools were not available in Kano state public secondary schools.

3.4.1 Sampling

The study sampled 8 upper basic schools from the 73 schools in the study area. To select the 8 schools, the 73 schools were stratified based on gender and location. This yielded 4 strata (viz. Male urban; Male rural; female urban; and female rural). Sixteen schools (4 schools from each group) were randomly selected using the 'draw from the hat' methods. The students in the schools were subjected to pretest using the Basic Science Performance Test (BSPT) and the Students' Attitude to Basic Science Questionnaire (SABSQ). The results of the pretests of BSPT from 11 schools however, were subjected to Analysis of variance ANOVA. The schools that had no significant differences were selected for the study. The result of the analysis is in Appendix P. The schools selected were randomly assigned into experimental and control groups with each containing male and female schools from both urban and rural areas. The summary of selected schools is presented in Table 3.2.

3.4.2 Sampling the Students

The second stage of the sampling involved the selection of students for the study. The sample consisted of two hundred and thirteen (213) Junior Secondary Two (JS II) students drawn from the eight (8) Junior Secondary Schools in the zone. Students from the urban schools (with relatively high population) were randomly selected from their class registers at a regular intervals, while those from the rural schools with low population in their classes, intact classes were purposefully selected as sample; taking cognizance of the recommended sample population accepted to be sufficient for experimental research by Fraenkel and Wallen (2000), and Kerlinger and Lee (2005). Similarly, Currier in Lunsford and Lunsford (1995) observed that at least 15- 30 subjects should be gathered for experimental studies involving the comparison of groups. The sampled schools are presented in Table 3.2.

Table 3.2: Sampled Schools for the Study.

Sn	Name of school	Gender	Location	Sampled size	Group
1	Government Secondary School Bude	M	Urban	27	Experimental
2	GSSS Kiyawa	M	Rural	24	Experimental
3	GGJISS Kiyawa	F	Rural	21	Experimental
4	Government Girls Sec. Sch. Bichi	F	Urban	30	Experimental
5	Mallam Wada Girls Junior Arabic Secondary School Bichi	F	Urban	30	Control
6	GGJSS Badume	F	Rural	24	Control
7	GJSS Badume	M	Rural	30	Control
8	Aminu Galadima J. S. S. Bichi	M	Urban	27	Control
	Total			**213**	

3.5 Selection of Basic Science Concepts to be Taught

For the purpose of this study, topics in the theme that were perceived difficult by Basic Science teachers and students (Ogunkola and 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. Kinetic theory of matter (osmosis)

vi. separation Techniques

vii. sounds

Ogunkola and Samuel (2011) reported varied perception of difficulty on Basic Science topics. Similarly, Peni (2013) observed that most of the topics were either omitted or partially touched in the Kano State Junior Secondary Certificate Examinations 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 primary and secondary levels.

3.6 Instrumentation

Three instruments were used for the study, these are:

i. Basic Science Performance Test (BSPT);

ii. The Students' Attitude to Basic Science Questionnaire (SABSQ);

iii. The Instructional Instrument (Lesson Plan).

3.6.1 The Basic Science Performance Test (BSPT)

The Basic Science Performance Test (Appendix D) was developed by the researcher based on the selected topics to be taught and the 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 25 multiple choice (objective) tests. The test items were adapted from the Kano State Junior Secondary Certificate Examination (2008 – 2012). The BSPT 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 subjects' 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 3.3: Table of Specifications (Test Blue Print) for BSPT

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

3.6.2 Validation of the Basic Science Performance Test (BSPT)

The instrument was validated by the following set of experts in.

1. Measurement and Evaluation (A Chief Lecturer in FCE (T) Bichi)

2. Basic Science (Science Education); (A Professors and a Senior Lecturer at the Bayero University Kano).

3. English Language specialist (Senior Lecturer FCE (T) Bichi).

The experts critically examined and assessed the items of the instruments relative to the following:

1. Appropriateness of the language used relative to the reading difficulty level of the students;
2. Clarity of the test items;
3. The conformity of the items with the subject specifications the items are to test.

The identification of the difficulty and discrimination indices of the items as well as the comments, observations and advises of the experts provided the basis for which the final draft of the performance test (Appendix D) was developed.

3.6.3 Pilot Testing the Basic Science Performance Test (BSPT)

The BSPT was pilot tested using a randomly selected school that were not be used for the main study (Government Secondary School Bichi and Government Girls Arabic Junior Secondary School Bude, Bichi). 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 male 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 forty item BSPT was administered and timed, the average time taken by the students to respond to the forty items was 50 minutes, and thus a final time of 30 minutes was adopted for the main study with a test containing twenty five items.

3.6.3.1 BSPT Item Analysis

Item analysis refers to the determination of the difficulty (Facility Index) and discrimination indices of a given test item. The procedure for determining the indices are presented as follows:

3.6.3.2 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.

3.6.3.3 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 is summarized in Table 3.4.

Table 3.4: 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 BSPT were selected, modified or rejected. The corrected version of the BSPT based on the above criteria is at the Appendix E.

3.6.4 Reliability of the Basic Science Performance Test (BSPT)

The reliability of the BSPT was ascertained using the test retest method. In this approach, the candidates were tested with the BSPT and retested two weeks later. The reliability coefficient was computed using the Pearson's Product Moment Correlation Coefficient (PPMCC) using the Statistical Package for Social Sciences (SPSS) version 16.0. (Appendix, F).

The value of the Pearson 'r' obtained from the analysis ($r= 0.658$; $p<0.05$) shows a significant correlation in the pair of scores.

3.6.5 The Students' Attitude to Basic Science Questionnaire (SABSQ).

The Students' Attitude to Basic Science Questionnaire (SABSQ) was developed by the researcher to assess students' attitude to Basic Science (Appendices G). The instrument contained 20 items developed on a five point Likerts' scale of

Strongly Agree (SA), Agree (A), Undecided (U), Disagree (D), Strongly Disagree (SD).

3.6.6 Validity of the SABSQ

The instrument was validated by two Chief Lecturers in Educational Psychology and one Senior Lecturer (English) from the Federal College of Education (Technical) Bichi. The validators were requested to ascertain the relevance of the items at assessing the variable concerned (attitude). They also to verified the clarity and simplicity of language used in developing the items to ensure that the target students can conveniently respond to them.

3.6.7 Reliability of the SABSQ

The SABSQ was pilot tested to establish its reliability using the test retest method. The reliability coefficient of the final SABSQ was obtained by subjecting the students test and retest scores to the Cronbach Alpha statistic on the Statistical Package for Social Sciences (SPSS) software at $p \leq 0.05$. The coefficient was 0.75 (Appendix H).

3.6.8 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 the Bayero University Kano and the Federal College of Education (Technical) Bichi. The validation was meant to ensure appropriateness of the stated objective, and the relevance of the instructional materials to the objective of the study.

3.7.1 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 (six 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.

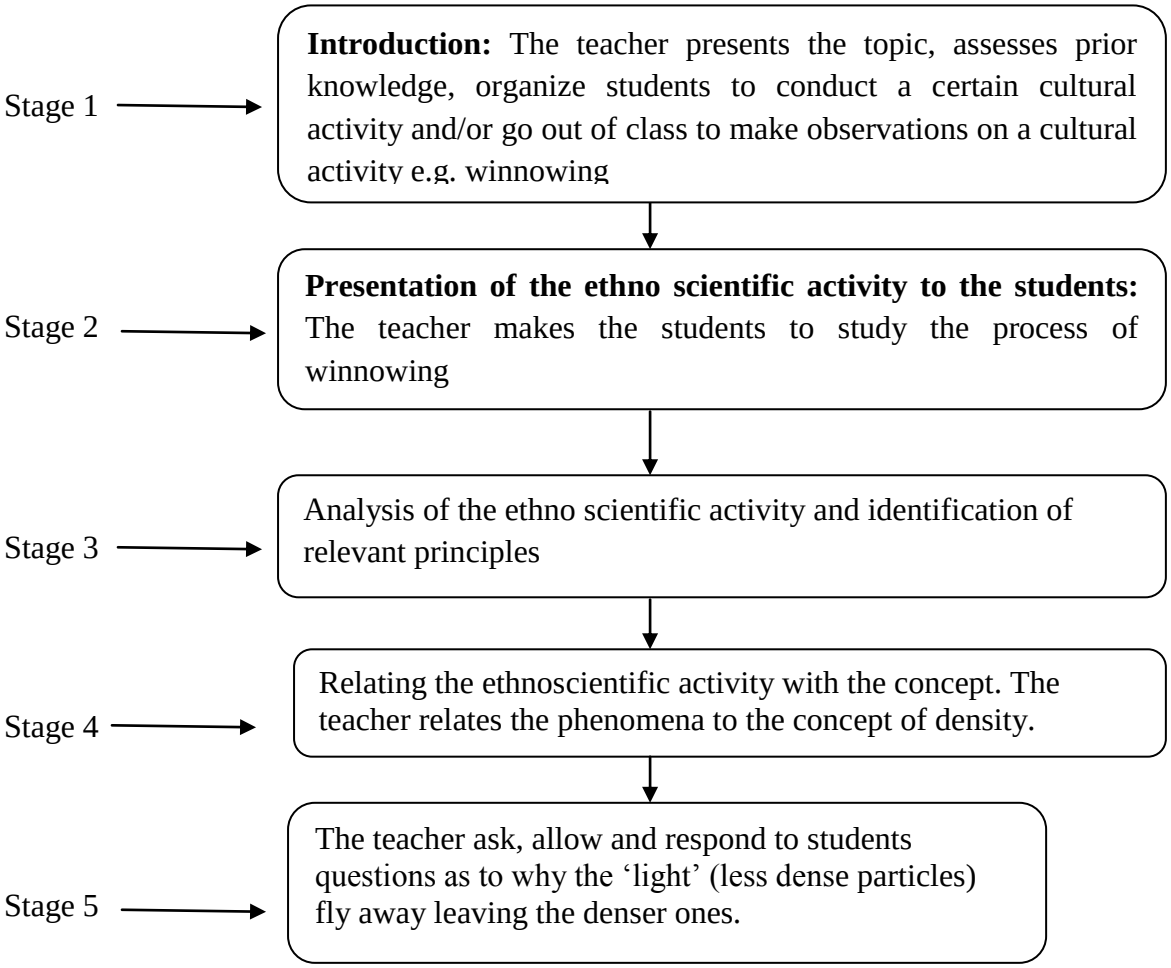


Figure 3.2: Flow Chart of Ethnoscience-enriched-instruction adapted from Achor, Imoko and Uloko (2009)

3.7.2 Teaching the Control Group

The control group was taught Basic Science concepts using lecture Method. The teaching was done for a period of six weeks of 2 hour teaching per week. The teaching was be 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 detail of the lesson plan is presented in Appendix B.

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.

3.8 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 and attitude;

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

iv. The experimental groups were further posttested two weeks after the first posttest to assess the extent of retention of learnt concepts.

3.9 Procedure for Data Analysis

The data were analyzed 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 $p \leq 0.05$ were tested as follows:

Ho_1 There is no significant difference between the academic performance mean scores of urban and rural Basic Science students' taught using ethnoscience-enriched-instruction compared to those taught using lecture method;

Statistic: Two Way Analysis of Variance (ANOVA)

Ho_2 There is no significant difference between the academic performance mean scores of JS II male and female Basic Science students taught using ethnoscience-enriched-instruction and those taught using lecture method;

Statistic – Independent Sample t-test

Ho_3 There is no significant difference in the retention of Basic Science concepts between urban and rural students taught using ethnoscience-enriched-instruction and those taught using lecture method;

Statistic – Two Way Analysis of Variance (2 Way ANOVA)

Ho_4 There is no significant difference in retention of Basic Science concepts between male and female students taught using ethnoscience-enriched-instruction;

Statistic – Independent Sample t-test

Ho_5 There is no significant difference in the mean attitude ranks among urban and rural students taught Basic Science concepts using ethnoscience-enriched-instruction and those taught using lecture method;

Statistic – Kruskal-Wallis H test

Ho_6 There is no significant difference in mean attitude score of male and female students taught Basic Science concepts using ethnoscience-enriched-instruction;

Statistic – Mann Whitney U test

CHAPTER FOUR

DATA ANALYSIS, RESULTS AND DISCUSSION

4.1 Introduction

In the previous chapter, a brief description of the methodology employed in the study was presented. In this chapter, the description of data analysis, results and discussion of the results is presented. The chapter is presented under the following subheadings:

4.2 Data Analysis and Results;

4.3 Summary of Findings;

4.4 Discussions of Results.

4.2 Data Analysis and Results

Five types of data were collected from the subjects of this study. The data include:

1. Pretest posttest and post-posttest scores of students performance (BSPT);
2. Pretest and posttest scores of students attitudes to Basic Science (SABSQ)

The performance scores from the pretest, posttest and post posttest were compiled and recorded for the experimental and control groups. The Pretest data were obtained by the administration of the BSPT and SABSQ before the commencement of the study. The administration of the BSPT and SABSQ immediately after the treatment generated the posttest data. While the post-posttest data were generated by the re-administration of the BSPT to both the experimental and control groups two weeks after the posttest.

The data were analyzed using the statistical Package for Social Sciences (SPSS) version 21 at 0.05 level of significance to answer the research question and test the null hypotheses.

Answering Research Questions

Research Question 1. What is the difference between the academic performance mean scores of urban and rural Basic Science students' taught using ethnoscience-enriched-instruction and those taught using lecture method?

Table 4. 1: Mean and Standard Deviation of Posttest Scores of Urban and Rural Students in Experimental and Control Groups

Location	Treatment	N	Mean	Std. Deviation	Mean diff
Urban	Experimental	58	17.71	3.66	8.3498
	Control	56	9.36	4.17	
Rural	Experimental	44	17.16	2.68	8.4500
	Control	55	8.71	3.52	
Urban	Experimental	58	17.71	3.27	0.5478
Rural	Experimental	44	17.16	2.68	

The result in Table 4.1 presents a comparison of the means of experimental and control groups in the study. The urban experimental group recorded a mean score of 17.71 and a standard deviation of 3.66 in contrast to the urban control group with a mean score of 9.36. The mean difference between the two groups was 8.35. Similarly, the rural experimental group recorded a mean score of 17.16 and a Standard Deviation of 2.68 in contrast to the rural control group with a mean score of 8.71 and a mean difference 8.45. The two comparisons showed that there was relatively marked difference in performance between experimental groups and control groups in favor 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 0.55. The difference in the scores between the experimental and

control groups is an indication of the potency of ethnoscience-enriched-instruction at enhancing academic performance among subjects in the experimental groups. Similarly, the performance of experimental group is an indication that the treatment had the potency of enhancing academic performance between urban and rural student.

Research Question 2: What is the difference between the academic performance mean scores of JS II male and female Basic Science students taught using ethnoscience-enriched-instruction and those taught using lecture method?

Table 4.2: Means of Posttest Scores of Male and Female Students in Experimental Groups

Gender	N	Mean	SD	Mean Diff.
Male	51	17.24	3.34	0.47
Female	51	17.71	3.21	

From the results in Table 4.2, the male and female schools have means and standard deviation of 17.24 (3.34) and 17.71 (3.21) respectively with a mean difference of 0.47. The means were relatively ‘close’, this suggests that ethnoscience-enriched-instruction had enhanced the academic performance of both male and female students

Research Question 3: What is the difference in the retention of Basic Science concepts between urban and rural students taught using ethnoscience-enriched-instruction and those taught using lecture method?

Table 4. 3: Mean and Standard Deviation of Postposttest Scores of Urban and Rural Students in Experimental and Control Groups

Location	Treatment	N	Mean	Std. Deviation	Mean diff
Urban	Experimental	58	16.68	4.04	6.09
	Control	56	10.59	3.56	
Rural	Experimental	44	16.31	2.51	7.56
	Control	55	8.75	3.92	
Urban	Experimental	58	16.68	4.04	0.37
Rural	Experimental	44	16.31	2.51	

The result in Table 4.3 revealed that urban experimental schools had a mean performance score of 16.68 while the urban control group had a mean of 10.59. The mean difference was 6.09 in favor 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 16.31 and that of the control group was 8.75 with a mean difference was 7.56. However, the comparison of the means of both urban and rural experimental groups showed a mean difference of 0.37. 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 4: What is the difference in retention of Basic Science concepts between male and female students taught using ethnoscience-enriched-instruction?

Table 4.4: Means of Post-posttest Scores of Male and Female Students in Experimental Groups

	Gender	N	Mean	Std. Deviation	Mean Diff.
Postposttest	Female	50	16.54	3.41	
					0.91
	Male	51	15.63	3.58	

The results in Table 4.4 revealed that the means of female (16.54) and male (15.63) students retention scores were relatively close with a mean difference of 0.91 in favor of the female students that had higher mean than that of the males. This showed that ethnoscience-enriched-instruction had enhanced retention of concepts among female students than male students. The significance of this difference was tested based on the corresponding hypothesis.

Research Question 5: What is the difference in the mean attitude ranks among urban and rural students taught Basic Science concepts using ethnoscience-enriched-instruction and those taught using lecture method?

Table 4.5: Mean Ranks of Students Attitude Scores in Experimental and Control Groups.

	Groups	N	Mean Ranks	Mean Rank diff
	Experimental	57	161.37	
Urban				90.97
	Control	57	70.40	
	Experimental	45	144.40	
Rural				87.33
	Control	54	57.07	
Urban	Experimental	57	161.37	
				16.97
Rural	Experimental	45	144.40	

Table 4.5 shows that the mean ranks of schools in the experimental groups are higher than those in the control groups. Comparison between experimental and control groups in urban schools showed a mean rank difference of 90.97. Similarly, mean rank difference between experimental and control groups in rural schools was 87.33 in favor of the experimental group. The mean ranks difference of experimental groups in urban and rural schools showed a difference of 16.97. It could be seen that the experimental groups have persistently showed higher mean ranks than the control groups. This is an indication that the ethnoscience-enriched-instruction had influenced students' attitude to Basic Science more than the control group.

Research Question 6: What is the difference in mean attitude score of male and female students taught Basic Science concepts using ethnoscience-enriched-instruction?

Table 4.6: Mean Ranks of Male and Female Students from Urban and Rural Location of Experimental Group

	Gender	N	Mean Rank	Sum of Ranks	Mean Rank Diff
Attitude	Female	51	59.39	3029.00	15.78
	Male	51	43.61	2224.00	
	Total	102			

The results in Table 4.6 showed that the mean ranks of the male (43.61) and female (59.39) with an attitude mean rank difference of 15.78 in favor of the female students that had higher mean ranks. This showed that the attitudes of female subjects in the experimental groups were more influenced by the ethnoscience-enriched-instruction than those of the male students. To ascertain the significance of the difference, the corresponding null hypothesis was tested at 0.05. This shows that the ethnoscience-enriched-instruction have impact on male and female attitude to Basic Science.

4.2.2 Hypothesis Testing

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

Ho_1 There is no significant difference between the academic performance mean scores of urban and rural Basic Science students' taught using ethnoscience-enriched-instruction compared to those taught using lecture method;

To test the hypothesis, the posttest performance scores of the experimental and control groups were subjected to Two Way Analysis of Variance (Appendix, I). The result is shown in Table 4.7.

Table 4.7: Two Way Analysis Variance for Posttest Scores of Subjects in the Experimental and Control Groups.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	3800.69[a]	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 4.7, the calculated F (1, 209) = 287.63; $p \leq 0.05$ 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 Scheffe's multiple comparison. The summary of the comparison is in Table 4.7a.

Table 4.7a: Scheffe's Multiple Comparisons of the Posttest Performance Scores of Students in Experimental and Control Groups of Urban and Rural Schools.

(I) groups1	(J) groups1	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Experimental Urban	Control Urban	8.36*	0.67	0.001	6.45	10.25
	Experimental Rural	0.55	0.72	0.911	-1.50	2.54
	Control Rural	9.00*	0.68	0.001	7.08	10.92
Control Urban	Experimental Rural	-7.83*	0.72	0.001	-9.85	-5.81
	Control Rural	0.65	0.68	0.826	-1.28	2.57
Experimental Rural	Control Rural	8.47*	0.73	0.001	6.43	10.52

Table 4.7b: Scheffes' Test of Homogeneity for Posttest Scores of Experimental and Control Groups in Urban and Rural Schools.

		Subset for alpha = 0.05	
Groups	N	1	2
Control Rural	54	8.70	
Control Urban	57	9.35	
Experimental Rural	45		17.18
Experimental Urban	57		17.70
Sig.		0.836	0.905

Means for groups in homogeneous subsets are displayed.

Result of the multiple comparisons (Table 4.7a) showed no significant difference in all the experimental groups at $p > 0.05$; however, it has persistently showed a significant difference between the schools in experimental groups and control groups at different p values. To be clearer, Table 4.7b further grouped the means into homogenous subsets in which schools in the experimental group are found clustered in a subset with higher mean scores while schools in the control group were clustered into a subset with lower mean scores. 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 lecture method. 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.

Similarly, Results of the comparison of students performance in experimental and control groups based on their location (urban and rural), the calculated $F(1, 209) = 18.815$; $p < 0.05$ revealed that there is significant difference in the academic performance of students in the urban and rural schools taught using ethnoscience-enriched-instruction and those taught using lecture method. Hence the null hypothesis

is rejected. A close study of the Scheffe's post hoc test and test of homogeneity of means reveals that the rural and urban students in the experimental groups differs significantly with their counterparts in the control groups due to the treatment. The results also confirmed that there is significant interaction between students' location and the instructional process they were exposed to. ($F(1, 209) = 0.010$; $p < 0.05$ (Table 4.7).

To confirm that the difference in the performance within the experimental groups was due to the treatment, the pretest and posttest results were subjected to paired sample t test (Appendix, J). The results revealed that $t(101) = 19.65$; $p < 0.05$ that there was significant difference between the pretest and the posttest scores. This shows that the instructional process significantly affected the academic performance of the students in the experimental groups.

Testing the Null Hypothesis 2 (Ho_2)

The null hypothesis 2 sought to find out if there was any significant difference in the academic performance of male and female students exposed to Basic Science concepts using ethnoscience-enriched-instruction. The null hypothesis is restated hereunder:

Ho_2 There is no significant difference in the academic performance of Male and Female students taught Basic Science concepts using ethnoscience-enriched-instruction;

To test null hypothesis 2, the scores of the male and female students from both urban and rural schools of the experimental group were subjected to Independent Sample t-test statistic (Appendix, K). The summary of the analysis is presented in Table 4.8.

Table 4.8: t-test Analysis of Posttest Scores Among Male and Female Schools of the Experimental Group.

Gender	N	Mean	Std. Deviation	Std. Error Mean	df	t value	P	Remark
Female	50	17.70	3.21	0.45				
					99	1.311	0.193	NS
Male	51	17.24	3.44	0.47				

Not Significant at $p<0.05$

From Table 4.8, the calculated $t(99) = 1.311$; $p > 0.05$ showed that there was no significant difference between the academic performance of male and female students in both urban and rural schools of the experimental group. Hence, the null hypothesis is retained.

Testing the Null Hypothesis 3 (Ho_3)

Null hypothesis 3 sought to find out if there exists any significant difference in the retention of Basic Science concepts among students taught using ethnoscience-enriched-instruction and those taught using lecture method among urban and rural students. The null hypothesis is restated as follows:

Ho_3 There is no significant difference in the retention of Basic Science concepts between urban and rural students taught using ethnoscience-enriched-instruction and those taught using lecture method;

To test the hypothesis, the post-posttest scores of the students in the experimental and control groups were subjected to Two Way ANOVA) (Appendix, L). The results are summarized in Table 4.9.

Table 4.9: Two Way Analysis of Variance of Post-Posttest Scores of Students in the Experimental and Control Groups.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	2310.67[a]	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-posttest scores of students in the experimental and control groups from urban and rural schools as revealed in Table 4.9, 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 Scheffe's multiple comparison. The summary of the analysis is presented in Table 4.9a.

Table 4.9a: Scheffe's Multiple Comparisons of the Post-posttest Performance Scores of Students in Experimental and Control Groups of Urban and Rural Schools

(I) groups	(J) groups	Mean Difference (I-J)	Std. Error	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

Table 4.9b: Scheffe's Test of Homogeneity of Means between Urban and Rural School of Experimental and Control Groups

		Subset for alpha = 0.05		
Groups	N	1	2	3
Control Rural	54	8.63		
Control Urban	57		10.67	
Experimental Rural	45			15.38
Experimental Urban	57			16.72
Sig.		1.000	1.000	0.304

Means for groups in homogeneous subsets are displayed.

From Table 4.9a, the Scheffe's 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 ($p = 0.001$). Similarly, the Scheffe's test of homogeneity (Table 4.9b) grouped the means into homogenous subsets based on the proximity of the values. Subsets 1and 2 revealed that the means of the urban anr rural schools in control groups to be significantly different from one another ($p = 0.034$) while the subset 3 showed that there was no significant difference between urban and rural students of the experimental groups ($p = 0.304$). This showed that

there was significant difference between schools in experimental and control groups in favor of the experimental groups that has higher means. Thus null hypothesis 4 was rejected.

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-posttest scores of students in the experimental groups from urban and rural schools as revealed in Table 4.9a, 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.

To establish that the difference in the retention within the experimental groups and control groups was due to the treatment, the pretest and postposttest results of the students in the experimental groups were subjected to paired sample t test (Appendix, M). The results revealed that $t(101) = 21.01$; $p < 0.001$ that there was significant difference between the pretest and the postposttest scores. This shows that the instructional process significantly enhanced the mean retention score s of the students in the experimental groups.

Testing Null Hypothesis 4 (Ho_4)

Null hypothesis 4 sought to find out the impact of ethnoscience-enriched-instruction on the retention of male and female students. The null hypothesis is restated as follows:

Ho_4 There is no significant difference in retention of Basic Science concepts between male and female students taught using ethnoscience-enriched-instruction.

To test the null hypothesis, the post-posttest scores of the male and female students were subjected to independent sample t-test statistic at 0.05 level of significance (Appendix, N). The summary of the results is presented in Table 4.10.

Table 4.10: Post-Posttest Comparison of Male and Female Students BSPT Scores

Gender	N	Mean	Std. Dev	Std. Error	Df	t	p value
Female	50	16.54	3.41	0.483	99	1.311	0.193
Male	51	15.63	3.58	0.50			

Results of the comparison of post-posttest scores of male and female students in the experimental group as revealed in Table 4.10, shows a calculated t (99) = 1.311; $p > 0.05$ reveal that there is no significant difference in the retention of learnt concepts among male and female students in the urban and rural schools. Hence, the null hypothesis is retained.

Testing the Null Hypothesis 5

Null hypothesis 5 sought to find out the difference in attitude to science among students taught with ethnoscience-enriched-instruction and those taught with lecture method. The hypothesis is restated as follows:

Ho_5 There is no significant difference in the mean attitude ranks among urban and rural students taught Basic Science concepts using ethnoscience-enriched-instruction and those taught using lecture method;

To test the hypothesis, the scores of students were subjected to Kruskal-Wallis H test (Appendix, O). The summary of the results are presented in Table 4.11.

Table 4.11: Kruskal Wallis H Test Analysis of Posttest Students Attitude Scores

Groups	N	Mean Rank	Df	Chi Square	p-value
Experimental Urban	57	161.37	3	116.979	0.001
Control Urban	57	70.40			
Experimental Rural	45	144.40			
Control Rural	54	57.07			
Total	213				

Results from Table 4.11 reveals that X^2 (3) = 133.05; $p < 0.05$, this implies that there is significant difference in the posttest attitude of students in the experimental and control groups in favor of the experimental groups that have higher mean ranks. This shows that the ethnoscience-enriched-instruction had positively influenced the attitude of the students in the experimental group. Therefore, null hypothesis 5 was rejected. This showed that there was significant difference between the posttest attitude scores of students in the experimental and control groups.

Testing the Null Hypothesis 6

This hypothesis sought to find out if ethnoscience-enriched-instruction have any impact on male and female students' attitude after the instruction. The null hypothesis is restated as follows:

Ho_6 There is no significant difference in mean attitude scores of male and female students taught Basic Science concepts using ethnoscience-enriched-instruction;

To test the hypothesis, the SABSQ of male and female students from urban and rural schools were subjected to Mann Whitney U test (Appendix, P). The summary of the analysis is presented in Table 4.12.

Table 4.12: Mann Whitney U test Analysis for SABSQ Ranks of Male and Female Students in Experimental Group

Gender	N	Mean Rank	Sum of Ranks	U	P value
Female	51	59.39	3029.00		
				898.00	0.007
Male	51	43.61	2224.00		
Total	102				

Results from Table 4.12 reveals that U (3) = 898.00; $p < 0.05$, this showed that there is significant difference in the posttest attitude of male and female students in the experimental group in favor of the female students that had higher mean ranks. This shows that the ethnoscience-enriched-instruction had positively influenced the attitude of the female students more than the male students in the experimental group. Therefore, null hypothesis 6 was rejected.

4.3 Summary of Findings

The followings are the major findings of this study.

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

2. Ethnoscience-enriched-instruction had significant effect on the academic performance of urban and rural students;

3. Ethnoscience-enriched-instruction is effective in enhancing academic performance among male and female students of both urban and rural schools;

4. Urban and rural school students taught Basic Science concepts using ethnoscience-enriched-instruction had significantly better retention of learnt concepts than their counter parts taught same concepts using lecture method;
5. Students exposed to ethnoscience-enriched-instruction developed more positive attitude to Basic Science than those exposed to lecture method of teaching.
6. The attitude of female students towards science has been improved by the ethnoscience-enriched-instruction than male students;
7. There is no significant difference in the attitude of urban and rural students taught Basic Science with ethnoscience-enriched-instruction;

4.4 Discussion of Results

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 relative 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 learners' 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 has, 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 favor 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.

Null hypothesis two assessed the impact of ethnoscience-enriched-instruction on the gender of the learners. The finding of the study revealed that there was no significant difference in the academic performance of male and female students. This shows that ethnoscience-enriched-instruction were gender friendly. Although a no significant difference was observed in the results, a close look at the means and standard deviations showed that the female students had higher mean (17.71) with a low standard deviation (3.21) compared to those of the male students (17.24) and a standard deviation of 3.34. it could be established that if the treatment period using the ethnoscience-enriched-instruction was extended, the female students will perform significantly better than the male students. This could be due to the fact that most of the practices are performed by the female as domestic chores. Other practices like blacksmithing, floating on calabash, dissection of animals are trades practiced by clans or based on inheritance. Thus, if one does not belong to a particular clan he may not be much interested and familiar with the practice. This therefore limits the participation of the male students in the practices. Therefore, the experiences the male students gained from the exposure to the practices could be temporal compared to those of female that were routine domestic chores.

This finding is in agreement with that of Sola and Ojo (2007) who reported that female students performed significantly better than their male counterparts when they were exposed to cooperative and competitive teaching methods. Similarly, Olagunju (2001) observed that allowing girls to participate in activity based instructional process that involves the activities they do at home encourages their

performances. It also agrees with Peni (2007) who reported a significant difference in favor of female students when he studied their ability to provide scientific interpretation to some Hausa culturally relevant practices. The ability stems from their familiarity with most of the practices than their male counterparts. Conclusively, Afonso (2007) reported that when student's sociology is involved in the instructional processes, their academic performance is enhanced.

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 three sought to find out if any significant difference exists in the retention of Basic Science concepts among students in the experimental and control groups. The results showed that a significant difference exist in favor 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 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.

Results from the testing of the null hypothesis four revealed that female students have had better retention of concepts than their male counterparts. This could be due to the fact that female students interact more with the cultural practices than

the males. For example, the practices of winnowing, cooking, treatment of stomach upsets on children, carrying loads on the head etc are usually domestic chores vested on women. While the practices of floating on water, dissection of animals etc even though are men oriented but are relatively dangerous that not all boys or men are involved. Thus even in this study, the male students were only made to keenly watch such practices as the specialists perform them. This involvement has the tendency to influence the retention of learnt concepts among female students. This finding is in agreement with Ogenyi (2015) who asserted that learners exposed to methods that provide very rich experiences from rich activities in the classroom brings about equal knowledge retention. He also concluded that students will always have greater retention gains in retention when directly engaged in the learning process with familiar practices. Lawson (2002) also agreed that students' retention ability can be enhanced through effective instruction. Aikenhead (2002) argued that students do not gain the desired retention ability unless when concerted efforts are made to identify and use instructional strategies that appeal to their concerts and have bearing to their cultural heritages. Thus, in this study, ethnoscience-enriched-instruction had proved to enhance the desired retention of learnt concept among male and female students.

The null hypothesis five sought the impact of ethnoscience-enriched-instruction on the attitudinal disposition of the students in the experimental and control groups. It has earlier been established in the pretest to this study that most of the students especially those from the rural areas have relatively low interest towards science (Appendix, Q). Similarly, 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 Basic 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 favorable attitudes towards the learning of science. Also, Olorukooba (2006) found in her study that using cooperative leaning helps develop learners' positive attitude to science.

The results of null hypothesis six compared the student's attitude based on gender revealed a significant difference in favor of the female students. This suggests that ethnoscience-enriched-instruction is friendlier to the female students than to males. This could be due to the fact that most of the ethnoscientific practices and

materials used in this study are conducted by females in the society. These results agreed with the findings of Abonyi (2002) who established that although, in his study the mean score of students interest to science between male and female was not statistically different; yet, the female students have relatively higher mean compared to males. Erinosho (1997) also opined that girls usually begin with positive attitude towards science but their interest diminishes as they proceed in the program due to poor teaching approach their teachers employ. Hence the use of culturally relevant practices that are familiar to the females enhanced their attitude towards the study of Basic Science.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

In this chapter, the objectives of the study, the methodology employed for the selection and treatment of subjects, the processes of data generation and summary of findings were briefly outlined. The conclusions emanating from the findings and requisite recommendations are presented. The chapter also highlighted the limitations of the study. The chapter is presented under the following subheadings:

5.2 Summary

5.3 Conclusion

5.4 Recommendations

5.5 Suggestions for further studies

5.2 Summary

This study investigated the effect of ethnoscience-enriched-instruction on attitude, retention and academic performance in Basic Science among Urban and Rural students in Kano State; and compared it with similar attitude, retention and academic performance in Basic Science that could be obtained when students are exposed to lecture method. The study also assessed gender related difference due to the treatment.

The sample comprised of 213 students from eight (4 Male and 4 female) Junior Secondary Schools under the Bichi Zonal Education Office, Kano state. The

sample was selected through simple random sampling after the schools were stratified based on gender and location.

Two instruments were used to collect data for the study. The 25 (Multiple choice) item Basic Science Performance Test (BSPT) 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 BSPT and SABSQ 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. Each group contained a male and a female urban school; and a male and a female rural school. The experimental groups were taught Basic 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 BSPT and SABSQ as posttests. The BSPT was further re-administered some two weeks after the posttest (Post-posttest). The results obtained were subjected to relevant statistics using the SPSS version 20 software at $p < 0.05$. The BSPT scores were subjected to Two Way Analysis of Variance and Independent Sample t-test; while the SABSQ data were analyzed using the Kruskal Wallis H test and Mann Whitney U test. The summary of findings and discussion of the results were presented.

5.3 Summary of Findings

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

2. Ethnoscience-enriched-instruction had significant effect on the academic performance of urban and rural students;
3. Ethnoscience-enriched-instruction is effective in enhancing academic performance among male and female students of both urban and rural schools;
4. Urban and rural school students taught Basic Science concepts using ethnoscience-enriched-instruction had significantly better retention of learnt concepts than their counter parts taught same concepts using lecture method;
5. Students exposed to ethnoscience-enriched-instruction developed more positive attitude to Basic Science than those exposed to lecture method of teaching.
6. The attitude of female students towards science has been improved by the ethnoscience-enriched-instruction than male students;
7. There is no significant difference in the attitude of urban and rural students taught Basic Science with ethnoscience-enriched-instruction;

5.4 Conclusion

From the findings of this study, the following conclusions are drawn:-

1. Instructional strategies adopted by teachers significantly affects students academic performance;

2. Ethnoscience-enriched-instruction is a viable innovation to the enhancement of students academic performance in Basic Science;
3. Ethnoscience-enriched-instruction enhances students retention of learn concepts in Basic Science;
4. Ethnoscience-enriched-instruction is gender friendly as it enhances male and female students academic performance and retention;
5. Ethnoscience-enriched-instruction has significantly enhanced the academic performance and retention of learnt concepts among rural students;
6. Ethnoscience-enriched-instruction has positive effect on urban and rural students attitude to Basic Science;
7. Ethnoscience-enriched-instruction has positive effect on male and female students attitude to Basic Science;
8. Ethnoscience and indigenous knowledges are not primitive and does not generate conflicts to learners when incorporated into Basic Science instructions;
9. Cultural knowledge has good relationship with advance scientific knowledge and therefore its inclusion into science instruction is necessary.

5.5 Contributions to Knowledge

The concern of this study was to determine the impact of ethnoscience-enriched-instruction on attitude, retention and academic performance among Basic Science students in urban and rural schools in Kano state, Nigeria. This study made the following contributions to knowledge and implications to educational practices.

1. The study has established the potency of ethnoscientific process as a viable tool for enhancing academic performance among Basic Science students;

2. The lingering differences in academic performance among urban and rural schools can be tackled using appropriate instructional procedures like ethnoscientific processes that provides learners with rich experiences from rich activities;
3. The instructional processes employed was found to be gender friendly;
4. The researcher developed Basic Science Performance Test (BSPT) and the Students Attitude to Basic Science Questionnaire (SABSQ) for the assessment of students academic performance and attitude to Basic Science respectively can be adopted/adapted by other researchers or serve as a guide to enable them the develop their own instruments for the measurement of the relevant variable of their interests.
5. The study of the impact of ethnoscience-enriched-instruction is the first of its kind in the area this study was conducted (Bichi Zonal Education Area, Kano state) and Kano at large. Thus, other researchers could replicate similar researches either at the same location or at other locations to further ascertain the efficacy of the instructional process.

5.6 Recommendations

This study has documented the impact of ethnoscience-enriched-instruction at enhancing the attitude, retention and academic performance of JS II students to Basic Science. It is therefore recommended that:

1. Government should enforce the use of ethnoscience-enriched-instruction in the Basic Science classroom instructions;
2. 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;

3. At the pre-service level, the use and implementation of ethnoscience-enriched-instruction in the classrooms should be emphasized in the methodology courses being offered by the Student-teachers; and
4. At the in-service level, seminars and workshops should be organized by ministry officials, zonal educational authorities, and local educational authorities in order to educate practicing teachers on how to implement ethnoscience- enriched-concepts.
5. Ethnoscience-enriched-instruction may be costly as they involve taking students out of classroom and/or school. Teachers should on one hand explore less costly approaches to its implementation; and on the other, Governments should make available adequate funds for its implementation;
6. 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.

5.7 Limitations of the Study

This study has the following limitations that hinder the generalization of its findings:

1. The difference between urban – rural difference today has been meek. Such that many people who live in either area intermingle with one another. As such

the generalizations of findings based on the urban – rural dichotomy will therefore be difficult;

2. The zone under which the study was conducted comprised of 73 schools with 5,113 students in the JSS II level. This use of 8 schools and a sample population of 213 reflect a gross underrepresentation of the total number of secondary schools in the zone and Kano state in general. This therefore poses some limitations to the generalization of the findings of this research.
3. Hausa language and tradition is dominant over all the northern part of the Federal Republic of Nigeria and to a larger extent the sub-Saharan Africa. The versatility of the language and the localization of groups at every point bring about some minor differences in the cultural practices of the people. As the study was conducted in Kano state which a minor sector of Hausa, the generalization of the findings among all Hausa cultures may not possible.
4. Lack of good language proficiency among the students in both experimental and control groups made the researcher to (most often) resort to use of native language to explain concepts.

5.8 Suggestions for Further Studies

It has been established from the available literatures that the exploration and use of ethnoscientific concepts and knowledges have not gain much of the popularity it deserved from science scholars in Africa. This status defined why science is still perceived by a large population as the ‘white man’s magic’! To change the status quo, researches should be conducted in relevant fields that will bring about a change in perception and attitude to science as well as enhance performance. This study

therefore puts forward the followings as recommended areas for further related studies.

1. 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;
2. The identified ethnoscientific concepts can be used to conduct similar researches in specialized science subjects like Chemistry, Physics, Biology, and Mathematics;
3. The current study involved only JS II students in Kano state, other levels (JS I and JS III) can be used to replicate the study to enable wider generalizations. Similarly, the study can be conducted using pre-service Basic Science teachers at the NCE and/or the B. Ed levels;
4. 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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Appendix A

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

Name of Schools:
Name of Researcher: Hussaini Yahaya Peni
Reg. No. Ph.D/EDUC/09615/2010-2011
Subject: Basic Science
Topic: Acids
Level of Group: J.S. II
Gender: Male & Female
No of Students:
Average age of Students:
Entry behavior: 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

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

- define acids;
- Identify the properties of acids
- Identify an acidic solution
- Mention some examples and sources of acids
- Mention uses of acids
- Arrange an acid/base titration
- 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 cofighter. Immediately, the man's face got 'burnt'. (the teacher and students further discuss the incidence and its implications)
b) 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. tamarind
iv. litmus paper
v. sample of inorganic acid
vi. 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 ask 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 taste 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 change blue litmus paper red,
iii. acids are corrosive;
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. production of soap
iii. HNO_3 for production of fertilizers
iv. HCl for removal of rust
v. HCl as electrolyte in acid accumulators

Name of Schools:
Name of Researcher: Hussaini Yahaya Peni
Reg. No. Ph.D/EDUC/09615/2010-2011
Subject: Basic Science
Topic: Bases
Level of Group: J.S. II
Gender: Male & Female
No of Students:
Average age of Students:
Entry behavior: 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: Ash, Potash (black and red), sample of standard base (Potassium/Sodium hydroxide), water

Behavioral Objectives: at the end of the lesson, students should be able to: -
define bases;

- Mention/list the properties of bases
- Classify strong and weak bases
- Mention some examples and sources of bases
- Mention uses of bases
- 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 soup was added, the sour taste disappeared. This shows that the potash and the sour taste have negative effects. The teacher thus ask: 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 ask 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:

i. bitter taste;
ii. change red litmus paper blue,
iii. corrosive tendencies;
iv. soapy feel to touch;
v. 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:

vi. bases have bitter taste;
vii. bases change red litmus paper blue,
viii. concentrated forms bases are corrosive;
ix. they are soapy to touch;
x. 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.

i. Why does their mothers' add potash to sour soups?
ii. What are bases?
iii. What are the properties of bases?
iv. What are the examples of bases that are often used in our homes?
v. What are the simple uses of bases

Lesson plan for experimental group (Ethnoscience-based instruction)

Name of Schools:
Name of Researcher: Hussaini Yahaya Peni
Reg. No. Ph.D/EDUC/09615/2010-2011
Subject: Basic Science
Topic: Forces
Level of Group: J.S. II
Gender: Male & Female
No of Students:
Average age of Students:
Entry Behavior: 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, pictures of women carrying loads freely on the head, donkeys carrying goods, maize cobs, palm oil.

Behavioral 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.

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?
v. What are the effects of forces on objects?
vi. What is the effect of balanced and unbalanced forces on objects?

Activity 1: 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 *(digirgire).*

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 Hausa 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.

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

vi. 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.

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

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

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

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

xi. 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 accelation 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 x a F = 5kg x $5m/s^2$ F = 25 kgm/s^2 F = 25N

Balanced forces

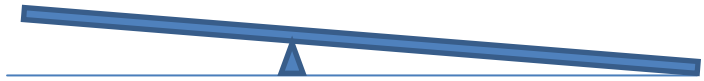
The teacher asks one of the students to carry a log of wood freely on his/ her head. The teacher asks the students to explain the bases of the stability of the wood. The students should also try placing the wood at different positions. The teacher identifies the name of the head in the set up (fulcrum/knife 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)



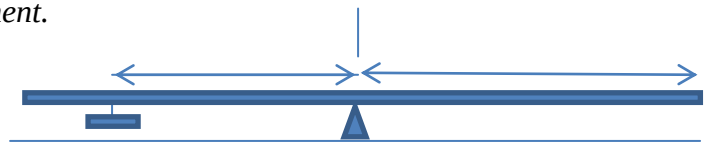
A b) B

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 acts 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.

Evaluation

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

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?

.

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

Name of Schools:
Name of Researcher: Hussaini Yahaya Peni
Reg. No. Ph.D/EDUC/09615/2010-2011
Subject: Basic Science
Topic: Density
Level of Group: J.S. II
Gender: Male & Female
No of Students:
Average age of Students:

Entry Behavior: 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.

Behavioral 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. 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 asks 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 $5cm^2$ has a mass of 2g. calculate the density of the body.

Density = 2/5
= 0.4

Evaluation

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

I Explain the density;
II Compute the magnitude of the densities of bodies;
III Identify the applications of density

Lesson plan for experimental group (Ethnoscience-based instruction)

Name of Schools:
Name of Researcher: Hussaini Yahaya Peni
Reg. No. Ph.D/EDUC/09615/2010-2011
Subject: Basic Science
Topic: Digestive System
Level of Group: J.S. II
Gender: Male & Female
No of Students:
Average age of Students:
Entry Behavior: 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.

Behavioral 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 (usually during a naming ceremony)
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	1. The function of oesophagus is to push food from the mouth to the stomach through peristalsis.
Stomach	1. 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 2. 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. 1. Pancreatic juice: contains: i. Amylopsin - carbohydrate ii. Trypsin - protein iii. Lipase – fats 2. Digested foods are absorbed into the blood by the walls 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

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.

Lesson plan for experimental group (Ethnoscience-based instruction)

Name of Schools:
Name of Researcher: Hussaini Yahaya Peni
Reg. No. Ph.D/EDUC/09615/2010-2011
Subject: Basic Science
Topic: Kinetic theory of matter (osmosis)
Level of Group: J.S. II
Gender: Male & Female
No of Students:
Average age of Students:
Entry Behavior:.
Instructional Materials: scene of calabash reformation after its wilting. Wilted calabash, Irish potato/yam, knife, water, common salt.

Behavioral Objectives: at the end of the lesson, the students 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;

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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.

i. Explain the concept of osmosis;
ii. Identify factors that determine its occurrence;
iii. Identify its application in every day life.

Lesson plan for experimental group (Ethnoscience-based instruction)

Name of Schools:
Name of Researcher: Hussaini Yahaya Peni
Reg. No. Ph.D/EDUC/09615/2010-2011
Subject: Basic Science
Topic: Separation Techniques

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

Level of Group: J.S. II
Gender: Male & Female
No of Students:
Average age of Students:
Entry Behavior: 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.

Behavioral 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

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Activity1: evaporation to dryness

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 ask 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.

Lesson plan for experimental group (Ethnoscience-based instruction)

Name of Schools:
Name of Researcher: Hussaini Yahaya Peni
Reg. No. Ph.D/EDUC/09615/2010-2011
Subject: Basic Science
Topic: Sound
Level of Group: J.S. II
Gender: Male & Female
No of Students:
Average age of Students:

Entry Behavior: The students are used listening to music from both traditional and western sources; students are familiar with voices and can distinguish persons based on their voices; familiar with various musical instruments around them.

Instructional Materials: Different sound instruments using membrane (drums *ganga, kotso, duma, gumbe*); strings (Guitar, *Molo, garaya, kuntigi*); columns (fluites, *sarewa, algaita*); bowl, water.

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

i. Define sound,
ii. Identify the basic characteristics of bodies that produce sound;
iii. Classify bodies based on their sound generating surfaces;
iv. Relate the nature of sound to the physical properties of the bodies;
v. Identify the various factors that affect the nature of sound produced by bodies;

Activity1: nature of sound

i. Spread some sand on the surface of the drum;
ii. Hit the surface of the drum and observe what happens to the sand;
iii. Why are the sand particles moving?
iv. Blow the whistle. What is causing the sound?
v. Hit the sting on the 'molo' guitar, what happen to it use a finger to press one end of the string what do you feel.

Thus all objects producing sound does so by vibrating their surfaces or the air in or around them.

Activity 2: factors that affect the quality of sound

i. The teacher asks the students to play three types of drums that use different skin types. And observes which one produces 'heavy' sound and which produces 'light' sound?
ii. What is responsible for the differences in the sounds?
iii. Consider the black spot on the small drum, what is it meant for?
iv. What is its name in Hausa language?
v. When it is removed, what is the difference in the sound produced?
vi. Repeat the same procedures i, on local flutes and guitars and compare the sounds. The students should also identify the causes of the differences in the sound quality

Evaluation

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

i. Define sound
ii. ,Identify the basic characteristics of bodies that produce sound;
iii. Classify bodies based on their sound generating surfaces;
iv. Relate the nature of sound to the physical properties of the bodies;
v. Identify the various factors that affect the nature of sound produced by bodies

Conclusion

The lesson will be concluded by the teacher going over what was taught to the students. The following notes will also be given to students to ease their revision.

Sound: is the form of energy produced by bodies due to the vibration of their surfaces.

Substances are classified based on the nature of substances that vibrate in them to generate the sound. They are classified as follows:

SN	Vibrating surfaces	Examples
1	Air in column	Flutes, *sarewa, shantu, algaita, kaho, etc*
2	Membrane	Drums (ganga, kalangu, kotso, duma, gumbe, etc.
3	String	Guitar (molo, kuntigi, garaya, gurumi.

Different bodies produce sounds due to their properties. Such properties are said to affect the quality of sound. They include:

1. The mass per unit length of the string/membrane;
2. The tension on the string;
3. The length of the string.

Appendix B

Lesson plan for Control group (Lecture Method)

Name of Schools:
Name of Researcher: Hussaini Yahaya Peni
Reg. No. Ph.D/EDUC/09615/2010-2011
Subject: Basic Science
Topic: Acids
Level of Group: J.S. II
Gender: Male & Female
No of Students:
Average age of Students:
Entry behavior: the students are used to feeding/eating from materials that have sour taste.
Instructional Materials: litmus paper, HCl, H_2SO_4 (dilute)

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

- define acids;
- Identify the properties of acids
- Identify an acidic solution
- Mention some examples and sources of acids
- Mention uses of acids
- Arrange an acid/base titration
- 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 cofighter. 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;
- Identify the properties of acids
- Identify an acidic solution
- Mention some examples and sources of acids
- Mention uses of acids
- Arrange an acid/base titration
- 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 Schools:
Name of Researcher: Hussaini Yahaya Peni
Reg. No. Ph.D/EDUC/09615/2010-2011
Subject: Basic Science
Topic: Bases
Level of Group: J.S. II
Gender: Male & Female
No of Students:
Average age of Students:
Entry behavior: 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
Behavioral Objectives: at the end of the lesson, students should be able to: -
define bases;

- Mention/list the properties of bases
- Mention some examples and sources of bases
- Mention uses of bases
- Produce salt from acid/base reactions

Step 1: Introduction.
The teacher observes that teacher introduces the lesson by presenting some beakers containing liquids. He ask 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 ask 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 (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 questions as follows:

i. Mention/list the properties of bases
ii. Mention some examples and sources of bases
iii. Mention uses of bases

Name of Schools:
Name of Researcher: Hussaini Yahaya Peni
Reg. No. Ph.D/EDUC/09615/2010-2011
Subject: Basic Science
Topic: Forces
Level of Group: J.S. II
Gender: Male & Female
No of Students:
Average age of Students:
Entry Behavior: 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:
Behavioral Objectives: at the end of the lesson, the students should be able to:

- Explain the concept of force;
- Apply force to operate a machine;
- Solve arithmetical problems involving forces;
- Demonstrate balanced and unbalanced forces;
- State the principle of moment;
- Solve the simple problems involving the equilibrium of forces;
- 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

- 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.
- the teacher explains the relationship between force and movement as well as derive the mathematical relationship.
- The teacher solves some simple problems involving forces.

Types of forces:

- Field force – centrifugal, centripetal, magnetic, gravitational forces etc.
- Contact forces – push, pull

Effect of forces on bodies
The teacher explains the effect of forces on bodies:

i. Forces cause movement;
ii. It deforms bodies;
iii. Makes objects to stop moving;
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 accelation 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

iv. It causes motion, retard or stop motion;
v. It leads to the deformation of the shape of objects;
vi. 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 x a F = 5kg x $5m/s^2$ F = 25 kgm/s^2 F = 25N

Balanced forces (moment of a force)

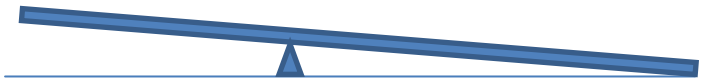
The teacher explains the concept of balanced forces as two or more forces that act on a body to keep it at equilibrium (Stable position). They can be Parallel forces acting in the same direction with one another. They can act vertically downwards, upwards or

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

a)



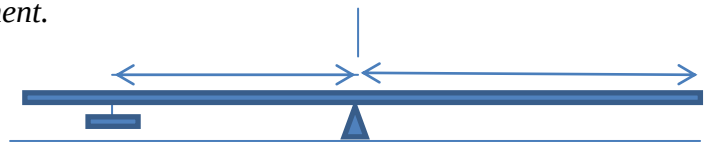
b) A B

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 acts 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;
- Apply force to operate a machine;
- Solve arithmetical problems involving forces;
- Demonstrate balanced and unbalanced forces;
- State the principle of moment;
- Solve the simple problems involving the equilibrium of forces;

Explain friction

Name of Schools:
Name of Researcher: Hussaini Yahaya Peni
Reg. No. Ph.D/EDUC/09615/2010-2011
Subject: Basic Science
Topic: Density
Level of Group: J.S. II
Gender: Male & Female
No of Students:
Average age of Students:
Entry Behavior: 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.

Behavioral 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

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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 $5cm^2$ has a mass of 2g. calculate the density of the body.

Density = 2/5
= 0.4

Evaluation

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

I Explain the density;
II Compute the magnitude of the densities of bodies;
III Identify the applications of density

Name of Schools:
Name of Researcher: Hussaini Yahaya Peni
Reg. No. Ph.D/EDUC/09615/2010-2011
Subject: Basic Science
Topic: Digestive System
Level of Group: J.S. II
Gender: Male & Female
No of Students:
Average age of Students:
Entry Behavior: 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

Behavioral 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 uses the chart 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

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

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 the walls 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

Name of Schools:
Name of Researcher: Hussaini Yahaya Peni
Reg. No. Ph.D/EDUC/09615/2010-2011
Subject: Basic Science
Topic: Kinetic theory of matter (osmosis)
Level of Group: J.S. II
Gender: Male & Female
No of Students:
Average age of Students:
Entry Behavior:.
Instructional Materials: Irish potato/yam, knife, water, common salt.

Behavioral Objectives: at the end of the lesson, the students 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;

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Step 1: Introduction.

i. 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.
ii. 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;
iii. The teacher labels the two potatoes as 'specimens A and B'.
iv. The teacher adds salt in the hole on specimen A leaving that of B empty;
v. 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.
vi. The teacher makes students to make and record their observations on the level of the liquid in specimens A and B.
vii. What is the name of the process involved?
viii. 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 bases of the basis of the movement of water molecules
iv. Explain their importance in everyday life;

Name of Schools:
Name of Researcher: Hussaini Yahaya Peni
Reg. No. Ph.D/EDUC/09615/2010-2011
Subject: Basic Science
Topic: Separation Techniques

v. evaporation to dryness
vi. decantation
vii. filtration
viii. separation of immiscible liquids

Level of Group: J.S. II
Gender: Male & Female
No of Students:
Average age of Students:
Entry Behavior: The students are used separating substances based on size, color or shape.
Instructional Materials: beakers, filter paper, separation funnel, pot, source of heat.

Behavioral 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

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Activity1: evaporation to dryness

Introduction

i. 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?
ii. The teacher explains that when when water is heated, it vaporizes. Thus, dissolved solids can be separated from liquids by evaporation. Though the water may not be regained.
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: filter paper, funnel, conical flask, water from different sources.

i. The teacher explains the concept of filtration as a process of separating insoluble solids from a liquid.
ii. The teacher demonstrate the process as follows:

- place the funnel on the conical flask;
- Fold the filter paper to form a cone;
- Place the folded filter paper into the funnel;
- Pour the water through the filter paper,

- 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.

Name of Schools:
Name of Researcher: Hussaini Yahaya Peni
Reg. No. Ph.D/EDUC/09615/2010-2011
Subject: Basic Science
Topic: Sound
Level of Group: J.S. II
Gender: Male & Female
No of Students:
Average age of Students:
Entry Behavior: Students are used to blowing withsels, making simple drums etc.
Instructional Materials: Different sound instruments using membrane (drums *ganga, kotso, duma, gumbe*); strings (Guitar, *Molo, garaya, kuntigi*); columns (fluites, *sarewa, algaita*); bowl, water.

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

i. Define sound,
ii. Identify the basic characteristics of bodies that produce sound;
iii. Classify bodies based on their sound generating surfaces;
iv. Relate the nature of sound to the physical properties of the bodies;
v. Identify the various factors that affect the nature of sound produced by bodies;

Activity1: nature of sound

i. The teacher begins by defining sound as the energy produced by vibrating objects.
ii. Spread some sand on the surface of the drum;
iii. Hit the surface of the drum and observe what happens to the sand;
iv. Why are the sand particles moving?

Thus all objects producing sound does so by vibrating their surfaces or the air in or around them.

Activity 2: factors that affect the quality of sound

i. The teacher explains to the students the factors that affect the quality of sounds produced by bodies.

Evaluation

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

i. Define sound,
ii. Identify the basic characteristics of bodies that produce sound;
iii. Classify bodies based on their sound generating surfaces;
iv. Relate the nature of sound to the physical properties of the bodies;
v. Identify the various factors that affect the nature of sound produced by bodies;

Conclusion

The lesson will be concluded by the teacher going over what was taught to the students. The following notes will also be given to students to ease their revision.
Sound: is the form of energy produced by bodies due to the vibration of their surfaces. Substances are classified based on the nature of substances that vibrate in them to generate the sound. They are classified as follows:

SN	Vibrating surfaces	Examples
1	Air in column	Flutes, *sarewa, shantu, algaita, kaho, etc*
2	Membrane	Drums (ganga, kalangu, kotso, duma, gumbe, etc.
3	String	Guitar (molo, kuntigi, garaya, gurumi.

Different bodies produce sounds due to their properties. Such properties are said to affect the quality of sound. They include:

i. The mass per unit length of the string/membrane;
ii. The tension on the string;
iii. The length of the string.

Appendix C: Detailed Description of Population of the Study

Sn	Name of School	School Location	Gender	Population
1	Government Senior Secondary School Bichi	Urban	M	250
2	Government Secondary School Saye	Rural	M	74
3	Government Arabic Secondary School Kargon Bichi	Urban	M	82
4	Government Secondary School Bude Bichi	Urban	M	160
5	Government Secondary School Danzabuwa, Bichi	Rural	M	124
6	Government Secondary School Chiromawa	Rural	M	58
7	Government Girls Arabic Secondary School Dan Zabuwa, Bichi	Rural	F	368
8	Government Girls Day Secondary School Bichi	Urban	F	140
9	Government Girls Junior Arabic Secondary School Saye	Rural	F	67
10	Government Junior Secondary School D/Dorawa	Rural	M	19
11	Government Girls Junior Arabic Secondary School Bichi	Urban	F	174
12	Government Junior Secondary School Hagawa	Rural	M	40
13	Junior Secondary School Waire	Rural	M	4
14	Government Junior Secondary School Damargu	Rural	M	58
15	Government Junior Secondary School M/Sarari.	Rural	M	30
16	Government Junior Arabic Secondary School M/Garu	Rural	M	44
17	Government Junior Secondary School Dutsin Karya	Rural	M	30
18	Government Junior Secondary School Tinki.	Rural	M	28
19	Government Junior Secondary School, Garun Bature	Rural	M	20
20	Government Junior Secondary School, Muntsira	Rural	M	25
21	Government Junior Secondary School, Yola	Rural	M	37
22	Government Junior Secondary School, Aminu Galadima	Urban	M	146
23	Government Girls Junior Secondary School, Chiranchi	Urban	F	200

24	GGJSS/GJSS Badume	Rural	M/F	168
25	Mal. Wada Government Junior Arabic Secondary School, Bichi	Urban	M	110
26	Government Girls Junior Secondary School, K/Lamba	Rural	F	56
27	Government Secondary School, Bagwai	Rural	M	265
28	Government Secondary School, Kiyawa	Rural	M	57
29	Government Secondary School, Dangada	Rural	M	50
30	Government Secondary School, Gadanya	Rural	M	56
31	Government Girls Arabic Secondary School, Bagwai	Rural	F	40
32	Government Junior Secondary School, Gogori	Rural	M	71
33	Government Girls Junior Secondary School, Gadanya	Rural	F	20
34	Government Girls Junior Secondary School, Dangada	Rural	F	23
35	Government Girls Junior Islamic Secondary School, Kiyawa	Rural	F	26
36	Government Junior Secondary School, Badodo	Rural	M	13
37	Government Secondary School, Rimin Dako	Rural	M	22
38	Government Junior Secondary School, Wuro Bagga	Rural	M	22
39	GGJSS/GJSS Romo	Rural	M/F	55
40	Government Junior Islamic Secondary School, Moji	Rural	M	10
41	Government Girls Junior Arabic Secondary School, Gogori	Rural	F	68
42	Government Secondary School, Kunchi	Rural	M	35
43	Government Secondary School, Shuwaki	Rural	M	100
44	Government Secondary School, ‘Yandadi	Rural	M	44
45	Government Girls Secondary School, Shuwaki	Rural	F	60
46	Government Junior Secondary School, Gwarmai	Rural	M	17
47	Government Junior Secondary School, U/Gyartai	Rural	M	09
48	Government Girls Arabic Secondary School, U/Gyartai	Rural	F	90

49	Government Junior Secondary School, Matan Fada	Rural	M	32
50	Government Junior Secondary School, Gwadama	Rural	M	13
51	Government Girls Junior Secondary School, Kunchi	Rural	F	06
52	GJSS/GGJSS K/Kuka	Rural	M/F	48
53	Government Secondary School, Tsanyawa	Rural	M	112
54	Government Secondary School, Kabagiwa	Rural	M	60
55	Government Secondary School, Harbau	Rural	M	70
56	Government Secondary School, Dumbulum	Rural	M	90
57	Government Arabic Secondary School, Tsanyawa	Rural	M	60
58	Government Girls Secondary School, Tsanyawa	Rural	F	120
59	Government Junior Secondary School, 'Yanganau	Rural	M	66
60	Government Junior Secondary School, 'Yammamman	Rural	M	29
61	Government Secondary School, Kwandawa	Rural	M	80
62	Government Girls Junior Arabic Secondary School, Dunbulum	Rural	F	75
63	Government Junior Secondary School, Gurun	Rural	M	70
64	Government Girls Junior Secondary School, 'Yanchibi	Rural	F	57
65	Government Junior Secondary School, Daddarawa	Rural	M	79
66	Government Girls Junior Secondary School, Harbau	Rural	F	60
67	Government Junior Islamic Secondary School, Dumbulum	Rural	M	60
68	Government Girls Junior Secondary School, 'Yar Gwanda	Rural	F	95
69	Government Girls Junior Arabic Secondary School, Gogori	Rural	F	-
70	Government Girls Junior Secondary School, 'Yandadi	Rural	F	98
	TOTAL			5,113

Source: Kano State Secondary School Management Board Bichi Zonal Office (2014).

Appendix D

Basic Science Performance Test (BSPT) before pilot test

Basic 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) Ptylin b) Pancreatic Juice c) Insulin d) None

4. The relationship 'force is directly proportional to acceleration' can mathematically be represented as
   a) F = Ma b) F α Ma c) F = M d) F α a

5. In which of the following separation techniques are substances separated based on their densities?
   a) Winnowing b) Sieving c) Distillation d) Filtration

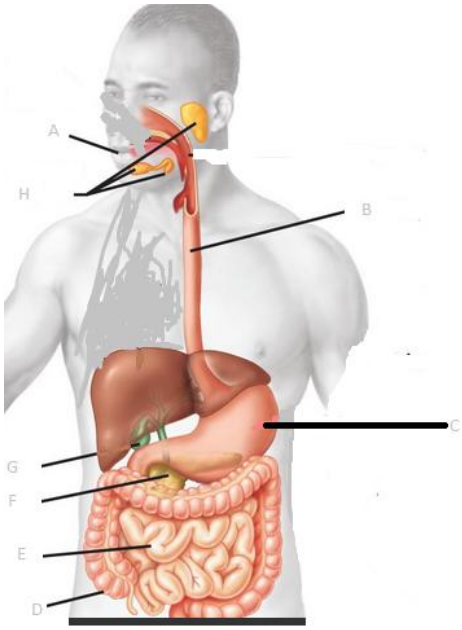
6. What is the name given to the process by which food substances are broken down into simpler forms ready to be absorbed by the body?
   a) Respiration b) digestion c) Excretion d) Growth

7. Excess carbohydrate is stored in the human body 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 acids and bases are …… and ……
   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 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 diagram that produces pancreatic juice is labeled …..
    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 c) Chemical reaction
    b) Neutralization reaction d) None

18. Which of the followings is not a characteristic property of an acid?
    a) Turns blue litmus paper red c) It is sour in taste
    b) 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) B is denser than A
c) A is heavier than B
d) B is heavier than A

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

a) Reabsorption of water
b) Absorption of food
c) Breakdown 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 prevents bodies from falling off slippery surfaces is called ….

a) Frictional force
b) Gravitational Force
c) Magnetic 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 unit of force is …. A) Kilogram b) Newton c) M/s d) Hp

26. During osmosis, water molecules move from 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 simple phenomenon that explains the kinetic theory of matter is ….

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 *akamu*, the simple separation technique employed 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 acids
b) Corrosive nature of base
c) Composition of the lemon
d) None

31. What is the mass of a body moving at $2m/s^2$ due to a force 1N

a) 2Kg b) 1Kg c) 3kg d) 4kg

32. On a 'kotso' drum, the '*dawa-dawa'* (black spot) is meant to ….

a) Decorate the drum

b) Increase the mass of the membrane

c) Limit the drumming space

d) None

33. Osmosis occur only in living cells … True or False

34. When water and palm oil are mixed together and allowed to settle, the palm oil floats on water because …

a) It does not dissolve c) It is less denser than water

b) It does not solidify d) None

35. A neutral solution is that which has a pH of …

a) 6 b) 8 c) 5 d) 7.

36. The simple approach to obtaining a base from our homes is …

a) Heating some water c) Socking sand in water

b) Burning of wood d) None

37. The nature of sound produced by a body is determined by all the followings except …..

a) The length of the string/membrane

b) The mass per unit length of the membrane

c) The tension on the membrane

d) The color of the membrane

38. Which of the followings produce sound due to the vibration of an air column in it?

a) Flute b) Drum c) Guitar d) Piano

39. The solids collected on filter paper after filtration is called …..

a) Solute b) Solvent

c) Residued) Filtrate

40. The strings around '*kalangu'* are meant to..

a) Hold the membrane in place

b) Increase the tension on the membrane

c) Make the drum beautiful

d) Provide a handle for the drum

Appendix E: BSPT after Pilot Testing

Basic Science Performance Test (BSPT)

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 following provides a mechanical breakdown of food during digestion in the mouth?

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

3. The relationship 'force is directly proportional to acceleration' can mathematically be represented as

a) F = Ma b) F = M c) F α Ma d) F α a

4. 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

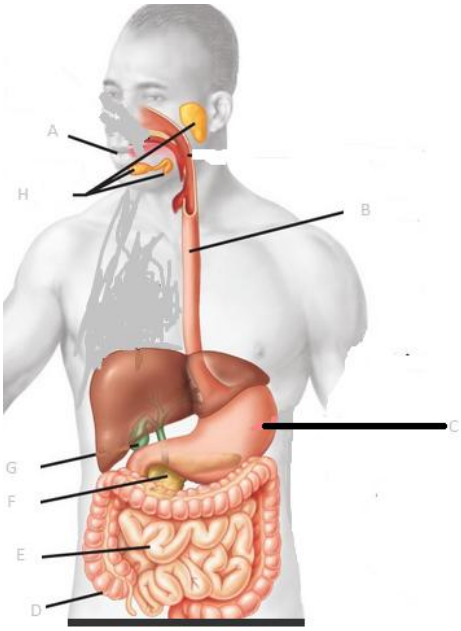
5. Calculate the density of a body of volume 4cm^3 and mass 8g.

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

6) The principal products between acids and bases are …… and ……

a) Water and Salt b) Water and Acid c) Water and Base d)soap

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



USE THE DIAGRAM ABOVE TO ANSWER QUESTIONS 8, and 9.

7. The part labeled C is called …..

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

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

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

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

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

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

True or False

11. Two bodies A and B were thrown into water, A floated and B sank. Which amongst the following simply explains the sinking of the latter?

a) A is denser than B b) B is denser than A

c) A is heavier than B d) B is heavier than A

12. 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

13. The force that prevents bodies from falling off slippery surfaces is called ….

a) Frictional force b) Gravitational Force c) Magnetic Force

d) Centripetal force

14. 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

15. During osmosis, water molecules move from region of ….

a) higher concentration to that of lower concentration

b) lower concentration to higher concentration

c) dry environment to wet environment

d) none

16. The simple phenomenon that explains the kinetic theory of matter is ….

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

17. In preparation of *akamu*, the simple separation technique employed is ……

a) Sedimentation b) distillation c) Chromatography d) Filtration

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

a) Corrosive nature of acids b) Corrosive nature of base

c) Composition of the lemon d) None

19. On a 'kotso' drum, the '*dawa-dawa'* (black spot) is meant to ….

a)Decorate the drum b) Increase the mass of the membrane

b)Limit the drumming space d) None

20. A neutral solution is that which has a pH of … a) 6 b) 8 c) 5 d) 7.

21. The nature of sound produced by a body is determined by all the following except …..

a) The length of the string/membrane b) The mass per unit length of the membrane

c) The tension on the membrane d) The color of the membrane

22. Which of the following produce sound due to the vibration of an air column in it?

a) Flute b) Drum c) Guitar d) Piano

23. The solids collected on filter paper after filtration is called …..

a) Solute b) Solvent c) Residue d) Filtrate

24. The strings around '*kalangu'* are meant to..

a) Hold the membrane in place

b) Increase the tension on the membrane

c) Make the drum beautiful

d) Provide a handle for the drum

Appendix F: Reliability Analysis of BSPT

```
CORRELATIONS
  /VARIABLES=TEST RETEST
  /PRINT=TWOTAIL NOSIG
  /STATISTICS DESCRIPTIVES

  /MISSING=PAIRWISE.
```

Correlations

Descriptive Statistics

	Mean	Std. Deviation	N
TEST	6.4800	2.88019	50
RETEST	7.6800	3.24786	50

Correlations

		TEST	RETEST
TEST	Pearson Correlation	1	.658**
	Sig. (2-tailed)		.000
	N	50	50
RETEST	Pearson Correlation	.658**	1
	Sig. (2-tailed)	.000	
	N	50	50

**. Correlation is significant at the 0.01 level (2-tailed).

Appendix G

The students' Attitude to Basic Science Questionnaire

Draft

Name of student …… Sex: M ( ) F ( ) please tick.

School …… Location: Urban ( ) Rural ( ) Age …..

Dear respondent,

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.					
14	Science involves the use of chemicals and they are dangerous.					
15	I am scared of science because people say it is difficult					
16	Those who study science do not relate well with people.					

17	Most of what is taught to us as science are things we have never seen with our eyes.					
18	I always encourage my friends to study science.					
19	I always look up to a science class.					
20	Most science inventors are 'white men' and so I do not think black people can be good scientists.					

Thanks

Hussaini Yahaya Peni

Appendix H: Reliability of SABSQ

```
GET
  FILE='C:\Users\USER\Documents\data for final correlation of SABSQ reliability
.sav'.
DATASET NAME DataSet2 WINDOW=FRONT.
RELIABILITY
  /VARIABLES=TEST RETEST
  /SCALE('ALL VARIABLES') ALL

  /MODEL=ALPHA.
```

Reliability

```
final correlation of SABSQ reliability.sav
```

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	50	100.0
	Excluded[a]	0	.0
	Total	50	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items

Reliability Statistics

Cronbach's Alpha	N of Items
.745	2

Appendix I: Two Way Analysis of Variance (ANOVA) for posttest scores in BSPT

Univariate Analysis of Variance

[DataSet3]

Between-Subjects Factors

		Value Label	N
location	1	urban	114
	2	Rural	99
treatment	1	exprimental 1	102
	2	control 1	111

Descriptive Statistics

Dependent Variable:posttest

location	Treatment	Mean	Std. Deviation	N
urban	exprimental 1	17.7069	3.66112	58
	control 1	9.3571	4.16666	56
	Total	13.6053	5.72623	114
rural	exprimental 1	17.1591	2.68452	44
	control 1	8.7091	3.52069	55

	Total	12.4646	5.27279	99
Total	exprimental 1	17.4706	3.27216	102
	control 1	9.0360	3.85635	111
	Total	13.0751	5.53667	213

Tests of Between-Subjects Effects

Dependent Variable:posttest

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	3800.692[a]	3	1266.897	98.136	.000
Intercept	36862.361	1	36862.361	2.855E3	.000
Location	18.815	1	18.815	1.457	.023
Treatment	3713.203	1	3713.203	287.631	.000
location * treatment	.132	1	.132	.010	.919
Error	2698.106	209	12.910		
Total	42913.000	213			
Corrected Total	6498.798	212			

Multiple Comparisons

Posttest

Scheffe

(I) groups1	(J) groups1	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Experimental Urban	Control Urban	8.35088*	.67311	.000	6.4538	10.2480
	Experimental Rural	.52398	.71658	.911	-1.4956	2.5436
	Control Rural	8.99805*	.68239	.000	7.0748	10.9213
Control Urban	Experimental Urban	-8.35088*	.67311	.000	-10.2480	-6.4538
	Experimental Rural	-7.82690*	.71658	.000	-9.8465	-5.8073
	Control Rural	.64717	.68239	.826	-1.2761	2.5704
Experimental Rural	Experimental Urban	-.52398	.71658	.911	-2.5436	1.4956
	Control Urban	7.82690*	.71658	.000	5.8073	9.8465
	Control Rural	8.47407*	.72531	.000	6.4299	10.5183
Control Rural	Experimental Urban	-8.99805*	.68239	.000	-10.9213	-7.0748
	Control Urban	-.64717	.68239	.826	-2.5704	1.2761
	Experimental Rural	-8.47407*	.72531	.000	-10.5183	-6.4299

*. The mean difference is significant at the 0.05 level.

Homogeneous Subsets

Posttest

Scheffe

groups1	N	Subset for alpha = 0.05	
		1	2
Control Rural	54	8.7037	
Control Urban	57	9.3509	
Experimental Rural	45		17.1778
Experimental Urban	57		17.7018
Sig.		.836	.905

Means for groups in homogeneous subsets are displayed.

Appendix J: Paired Sample T-Test of Pre and Posttest Performance Mean Scores of Students in the Experimental Groups

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	POSTTEST	12.6961	102	5.38753	.53345
	PRETEST	1.7255	102	1.15319	.11418

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	POSTTEST & PRETEST	102	-.117	.241

Paired Samples Test

	Paired Differences	t	df	Sig. (2-

		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				tailed)
					Lower	Upper			
Pair 1	POSTTEST - PRETEST	1.09706E1	5.64012	.55846	9.86276	12.07841	19.645	101	.000

Appendix K: Independent Sample t-test for Posttest scores of Male and Female Students in the Experimental group

[DataSet3]

Group Statistics

	Gender	N	Mean	Std. Deviation	Std. Error Mean
posttest	Female	51	17.7059	3.21431	.45009
	Male	51	17.2353	3.34418	.46828

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
posttest	Equal variances assumed	.276	.601	.725	100	.470	.47059	.64951	-.81803	1.75921
	Equal variances not assumed			.725	99.844	.470	.47059	.64951	-.81805	1.75923

Appendix L: Two Way Analysis of Variance (ANOVA) for Postposttest Scores in BSPT

Univariate Analysis of Variance

[DataSet3]

Between-Subjects Factors

		Value Label	N
Location	1	Urban	113
	2	Rural	99
Treatment	1	exprimental 1	101
	2	control 1	111

Descriptive Statistics

Dependent Variable:postposttest

location	Treatment	Mean	Std. Deviation	N
urban	exprimental 1	16.6842	4.03625	57
	control 1	10.5893	3.55618	56
	Total	13.6637	4.87085	113
rural	exprimental 1	15.2955	2.51118	44
	control 1	8.7455	3.92154	55
	Total	11.6566	4.68424	99
Total	exprimental 1	16.0792	3.50908	101
	control 1	9.6757	3.83800	111
	Total	12.7264	4.87771	212

Tests of Between-Subjects Effects

Dependent Variable:postposttest

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2310.667[a]	3	770.222	59.128	.000
Intercept	34506.159	1	34506.159	2.649E3	.000
Location	136.936	1	136.936	10.512	.001
Treatment	2095.321	1	2095.321	160.853	.000
location * treatment	2.714	1	2.714	.208	.649
Error	2709.465	208	13.026		
Total	39356.000	212			
Corrected Total	5020.132	211			

a. R Squared = .460 (Adjusted R Squared = .452)

Post Hoc Tests

Multiple Comparisons

postposttest
Scheffe

(I) groups1	(J) groups1	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Experimental Urban	Control Urban	6.05263*	.67518	.000	4.1497	7.9556
	Experimental Rural	1.34152	.71878	.326	-.6843	3.3673
	Control Rural	8.08967*	.68449	.000	6.1605	10.0188

Control Urban	Experimental Urban	-6.05263*	.67518	.000	-7.9556	-4.1497
	Experimental Rural	-4.71111*	.71878	.000	-6.7369	-2.6853
	Control Rural	2.03704*	.68449	.034	.1079	3.9662
Experimental Rural	Experimental Urban	-1.34152	.71878	.326	-3.3673	.6843
	Control Urban	4.71111*	.71878	.000	2.6853	6.7369
	Control Rural	6.74815*	.72753	.000	4.6977	8.7986
Control Rural	Experimental Urban	-8.08967*	.68449	.000	-10.0188	-6.1605
	Control Urban	-2.03704*	.68449	.034	-3.9662	-.1079
	Experimental Rural	-6.74815*	.72753	.000	-8.7986	-4.6977

*. The mean difference is significant at the 0.05 level.

Homogeneous Subsets

Postposttest

Scheffe

		Subset for alpha = 0.05		
groups1	N	1	2	3
Control Rural	54	8.6296		
Control Urban	57		10.6667	
Experimental Rural	45			15.3778
Experimental Urban	57			16.7193
Sig.		1.000	1.000	.304

Means for groups in homogeneous subsets are displayed.

Appendix M: Paired Sample T-Test of Pre and Posttest Performance Mean Scores of Students in the Experimental Groups

Paired Samples Statistics

	Mean	N	Std. Deviation	Std. Error Mean

Pair 1	POSTPOSTTEST	12.3564	101	4.87972	.48555
	PRETEST	1.7327	101	1.15664	.11509

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	POSTPOSTTEST & PRETEST	101	-.061	.545

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	POSTPOSTTEST - PRETEST	1.06238E1	5.08301	0.50578	9.62031	11.62721	21.005	100	.000

Appendix N: Independent Sample t-test for Postposttest Scores of Male and Female Students in the Experimental Groups

[DataSet3]

Group Statistics

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Postposttest	Female	50	16.5400	3.41192	.48252
	Male	51	15.6275	3.57749	.50095

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
postposttest	Equal variances assumed	.111	.739	1.311	99	.193	.91255	.69587	-.46820	2.29330
	Equal variances not assumed			1.312	98.926	.193	.91255	.69554	-.46756	2.29266

Appendix O: Kruskal Wallis test for the Equivalence of Means Attitude Scores of Students in the Experimental and Control Groups

[DataSet3]

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
Attitude	213	11.8967	4.73233	1.00	20.00
Attitudegroups	213	2.45	1.138	1	4

Kruskal-Wallis Test

Ranks

	Attitudegroups	N	Mean Rank
attitude	Experimental Urban	57	165.29
	Control Urban	57	72.94
	Experimental Rural	45	139.92
	Control Rural	54	53.99
	Total	213	

Test Statistics[a,b]

	Attitude
Chi-Square	121.756
Df	3
Asymp. Sig.	.000

a. Kruskal Wallis Test

b. Grouping Variable: attitudegroups

Appendix P: Mann Whitney test for Mean Attitude Scores of Male and Female Students in the Experimental Groups

[DataSet3]

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
attitude	213	12.1362	4.82967	1.00	21.00
gender	102	1.5000	.50247	1.00	2.00

Mann-Whitney Test

Ranks

	Gender	N	Mean Rank	Sum of Ranks
attitude	Female	51	59.39	3029.00
	Male	51	43.61	2224.00
	Total	102		

Test Statistics[a]

	attitude
Mann-Whitney U	898.000
Wilcoxon W	2.224E3
Z	-2.710
Asymp. Sig. (2-tailed)	.007

a. Grouping Variable: gender

Appendix P: Pretest Comparison of School for the study.

[DataSet0]

ANOVA

BSATSCORE					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	18.117	10	1.812	.930	.506
Within Groups	588.362	302	1.948		
Total	606.479	312			

Post Hoc Tests

Multiple Comparisons

BSATSCORE

Scheffe

(I) SCHOOLS	(J) SCHOOLS	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
GGSS BICHI	GSSS BUDE	.40000	.36039	1.000	-1.1552	1.9552
	MWJSS BICHI	.26667	.36039	1.000	-1.2885	1.8218
	AGJSS BICHI	.29259	.37027	1.000	-1.3052	1.8904
	GGJISS KIYAWA	.65455	.39179	.985	-1.0361	2.3452
	GGJSS BADUME	.13333	.36039	1.000	-1.4218	1.6885
	GSSS KIYAWA	.14828	.36348	1.000	-1.4202	1.7168
	GJSS BADUME	.60000	.36039	.986	-.9552	2.1552
	GJSS ROMO	.84815	.37027	.872	-.7496	2.4459
	GGJSS ROMO	.18276	.36348	1.000	-1.3858	1.7513
	GJSS MUNTSIRA	.28621	.36348	1.000	-1.2823	1.8547
GSSS BUDE	GGSS BICHI	-.40000	.36039	1.000	-1.9552	1.1552
	MWJSS BICHI	-.13333	.36039	1.000	-1.6885	1.4218

	AGJSS BICHI	-.10741	.37027	1.000	-1.7052	1.4904
	GGJISS KIYAWA	.25455	.39179	1.000	-1.4361	1.9452
	GGJSS BADUME	-.26667	.36039	1.000	-1.8218	1.2885
	GSSS KIYAWA	-.25172	.36348	1.000	-1.8202	1.3168
	GJSS BADUME	.20000	.36039	1.000	-1.3552	1.7552
	GJSS ROMO	.44815	.37027	.999	-1.1496	2.0459
	GGJSS ROMO	-.21724	.36348	1.000	-1.7858	1.3513
	GJSS MUNTSIRA	-.11379	.36348	1.000	-1.6823	1.4547
MWJSS BICHI	GGSS BICHI	-.26667	.36039	1.000	-1.8218	1.2885
	GSSS BUDE	.13333	.36039	1.000	-1.4218	1.6885
	AGJSS BICHI	.02593	.37027	1.000	-1.5719	1.6237
	GGJISS KIYAWA	.38788	.39179	1.000	-1.3028	2.0785
	GGJSS BADUME	-.13333	.36039	1.000	-1.6885	1.4218
	GSSS KIYAWA	-.11839	.36348	1.000	-1.6869	1.4501
	GJSS BADUME	.33333	.36039	1.000	-1.2218	1.8885
	GJSS ROMO	.58148	.37027	.991	-1.0163	2.1793
	GGJSS ROMO	-.08391	.36348	1.000	-1.6524	1.4846
	GJSS MUNTSIRA	.01954	.36348	1.000	-1.5490	1.5881
AGJSS BICHI	GGSS BICHI	-.29259	.37027	1.000	-1.8904	1.3052
	GSSS BUDE	.10741	.37027	1.000	-1.4904	1.7052
	MWJSS BICHI	-.02593	.37027	1.000	-1.6237	1.5719
	GGJISS KIYAWA	.36195	.40089	1.000	-1.3680	2.0919
	GGJSS BADUME	-.15926	.37027	1.000	-1.7570	1.4385
	GSSS KIYAWA	-.14432	.37328	1.000	-1.7551	1.4665
	GJSS BADUME	.30741	.37027	1.000	-1.2904	1.9052
	GJSS ROMO	.55556	.37988	.995	-1.0837	2.1948
	GGJSS ROMO	-.10983	.37328	1.000	-1.7206	1.5009
	GJSS MUNTSIRA	-.00639	.37328	1.000	-1.6172	1.6044
GGJISS KIYAWA	GGSS BICHI	-.65455	.39179	.985	-2.3452	1.0361
	GSSS BUDE	-.25455	.39179	1.000	-1.9452	1.4361
	MWJSS BICHI	-.38788	.39179	1.000	-2.0785	1.3028
	AGJSS BICHI	-.36195	.40089	1.000	-2.0919	1.3680

	GGJSS BADUME	-.52121	.39179	.998	-2.2119	1.1694
	GSSS KIYAWA	-.50627	.39463	.998	-2.2092	1.1967
	GJSS BADUME	-.05455	.39179	1.000	-1.7452	1.6361
	GJSS ROMO	.19360	.40089	1.000	-1.5363	1.9235
	GGJSS ROMO	-.47179	.39463	.999	-2.1747	1.2311
	GJSS MUNTSIRA	-.36834	.39463	1.000	-2.0713	1.3346
GGJSS BADUME	GGSS BICHI	-.13333	.36039	1.000	-1.6885	1.4218
	GSSS BUDE	.26667	.36039	1.000	-1.2885	1.8218
	MWJSS BICHI	.13333	.36039	1.000	-1.4218	1.6885
	AGJSS BICHI	.15926	.37027	1.000	-1.4385	1.7570
	GGJISS KIYAWA	.52121	.39179	.998	-1.1694	2.2119
	GSSS KIYAWA	.01494	.36348	1.000	-1.5536	1.5835
	GJSS BADUME	.46667	.36039	.998	-1.0885	2.0218
	GJSS ROMO	.71481	.37027	.958	-.8830	2.3126
	GGJSS ROMO	.04943	.36348	1.000	-1.5191	1.6179
	GJSS MUNTSIRA	.15287	.36348	1.000	-1.4156	1.7214
GSSS KIYAWA	GGSS BICHI	-.14828	.36348	1.000	-1.7168	1.4202
	GSSS BUDE	.25172	.36348	1.000	-1.3168	1.8202
	MWJSS BICHI	.11839	.36348	1.000	-1.4501	1.6869
	AGJSS BICHI	.14432	.37328	1.000	-1.4665	1.7551
	GGJISS KIYAWA	.50627	.39463	.998	-1.1967	2.2092
	GGJSS BADUME	-.01494	.36348	1.000	-1.5835	1.5536
	GJSS BADUME	.45172	.36348	.999	-1.1168	2.0202
	GJSS ROMO	.69987	.37328	.966	-.9109	2.3107
	GGJSS ROMO	.03448	.36655	1.000	-1.5473	1.6162
	GJSS MUNTSIRA	.13793	.36655	1.000	-1.4438	1.7197
GJSS BADUME	GGSS BICHI	-.60000	.36039	.986	-2.1552	.9552
	GSSS BUDE	-.20000	.36039	1.000	-1.7552	1.3552
	MWJSS BICHI	-.33333	.36039	1.000	-1.8885	1.2218
	AGJSS BICHI	-.30741	.37027	1.000	-1.9052	1.2904
	GGJISS KIYAWA	.05455	.39179	1.000	-1.6361	1.7452
	GGJSS BADUME	-.46667	.36039	.998	-2.0218	1.0885

	GSSS KIYAWA	-.45172	.36348	.999	-2.0202	1.1168
	GJSS ROMO	.24815	.37027	1.000	-1.3496	1.8459
	GGJSS ROMO	-.41724	.36348	.999	-1.9858	1.1513
	GJSS MUNTSIRA	-.31379	.36348	1.000	-1.8823	1.2547
GJSS ROMO	GGSS BICHI	-.84815	.37027	.872	-2.4459	.7496
	GSSS BUDE	-.44815	.37027	.999	-2.0459	1.1496
	MWJSS BICHI	-.58148	.37027	.991	-2.1793	1.0163
	AGJSS BICHI	-.55556	.37988	.995	-2.1948	1.0837
	GGJISS KIYAWA	-.19360	.40089	1.000	-1.9235	1.5363
	GGJSS BADUME	-.71481	.37027	.958	-2.3126	.8830
	GSSS KIYAWA	-.69987	.37328	.966	-2.3107	.9109
	GJSS BADUME	-.24815	.37027	1.000	-1.8459	1.3496
	GGJSS ROMO	-.66539	.37328	.976	-2.2762	.9454
	GJSS MUNTSIRA	-.56194	.37328	.994	-2.1727	1.0488
GGJSS ROMO	GGSS BICHI	-.18276	.36348	1.000	-1.7513	1.3858
	GSSS BUDE	.21724	.36348	1.000	-1.3513	1.7858
	MWJSS BICHI	.08391	.36348	1.000	-1.4846	1.6524
	AGJSS BICHI	.10983	.37328	1.000	-1.5009	1.7206
	GGJISS KIYAWA	.47179	.39463	.999	-1.2311	2.1747
	GGJSS BADUME	-.04943	.36348	1.000	-1.6179	1.5191
	GSSS KIYAWA	-.03448	.36655	1.000	-1.6162	1.5473
	GJSS BADUME	.41724	.36348	.999	-1.1513	1.9858
	GJSS ROMO	.66539	.37328	.976	-.9454	2.2762
	GJSS MUNTSIRA	.10345	.36655	1.000	-1.4783	1.6852
GJSS MUNTSIRA	GGSS BICHI	-.28621	.36348	1.000	-1.8547	1.2823
	GSSS BUDE	.11379	.36348	1.000	-1.4547	1.6823
	MWJSS BICHI	-.01954	.36348	1.000	-1.5881	1.5490
	AGJSS BICHI	.00639	.37328	1.000	-1.6044	1.6172
	GGJISS KIYAWA	.36834	.39463	1.000	-1.3346	2.0713
	GGJSS BADUME	-.15287	.36348	1.000	-1.7214	1.4156
	GSSS KIYAWA	-.13793	.36655	1.000	-1.7197	1.4438
	GJSS BADUME	.31379	.36348	1.000	-1.2547	1.8823

	GJSS ROMO	.56194	.37328	.994	-1.0488	2.1727
	GGJSS ROMO	-.10345	.36655	1.000	-1.6852	1.4783

Homogeneous Subsets

BSATSCORE

Scheffe

SCHOOLS	N	Subset for alpha = 0.05
		1
GJSS ROMO	27	3.8519
GGJISS KIYAWA	22	4.0455
GJSS BADUME	30	4.1000
GSSS BUDE	30	4.3000
AGJSS BICHI	27	4.4074
GJSS MUNTSIRA	29	4.4138
MWJSS BICHI	30	4.4333
GGJSS ROMO	29	4.5172
GSSS KIYAWA	29	4.5517
GGJSS BADUME	30	4.5667
GGSS BICHI	30	4.7000
Sig.		.875

BSATSCORE

Scheffe

SCHOOLS	N	Subset for alpha = 0.05
		1
GJSS ROMO	27	3.8519
GGJISS KIYAWA	22	4.0455
GJSS BADUME	30	4.1000
GSSS BUDE	30	4.3000
AGJSS BICHI	27	4.4074
GJSS MUNTSIRA	29	4.4138
MWJSS BICHI	30	4.4333
GGJSS ROMO	29	4.5172
GSSS KIYAWA	29	4.5517
GGJSS BADUME	30	4.5667
GGSS BICHI	30	4.7000
Sig.		.875

Means for groups in homogeneous subsets are displayed.