EFFECT OF FREEWRITING AND QUESTIONING BRAINSTORMING INSTRUCTIONAL STRATEGIES ON JUNIOR SECONDARY SCHOOL STUDENTS' LEARNING OUTCOMES IN BASIC SCIENCE IN OSUN STATE, NIGERIA

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CERTIFICATION

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DEDICATION

This research work is dedicated to: All Nigerian Children Who Deserve To Be Scientifically Literate.

ACKNOWLEDGEMENT

I am most grateful to God Almighty for what else has He not done for me to see me through this course.

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The cooperation of all the sampled schools is well-appreciated. There is no school with a Basic Science specialist teacher. In fact, in five out of the nine sampled schools, Youth Corpers were responsible for teaching Basic Science. However, all the teachers were ready to learn and enthusiastic about trying new methods.

It is interesting to note that l got married to my husband, father and friend, Sooko Moses Adewoyin Owoyomi, as a West African School Certificate holder, but for his love and understanding, I am now where I am now. Such a husband deserves appreciation. My children, Adeola, Funke, Opeyemi, Ayodeji, Olaleye and Oluwatosin and grandchildren are wonderfully supportive. Even when I got tired of paying tuition fees at University of Ibadan, the children took it up to encourage completion of the course.

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ABSTRACT

This study investigated effects of Freewriting Brainstorming Instructional Strategies (FBIS) and Questioning Brainstorming Instructional Strategies (QBIS) on Junior Secondary School (JSS) students' learning outcomes in Basic Science in Osun State, Nigeria. The moderating effects of gender and personality traits were also examined.

The pretest-posttest, control group, quasi experimental design involving 3x2x2 factorial matrix was employed. The research population comprised all the JSS II students in the state. Nine purposively selected state-owned co-educational secondary schools across the three Senatorial districts of the state were involved. Four hundred and fifty JSS II students from intact classes from the schools were used as research sample. The Research instrument were Attitude of Students to Basic Science Scale (Alpha coefficient (∞)=0.89), Students Personality Trait Scale (∞=0.94), Students' Basic Science Achievement Test (SBAT), Evaluation Sheet for Assessing Teachers' Performance during Training, and Teachers' Instructional Guides for FBIS and QBIS. Seven hypotheses were generated and tested at p=0.05. Data were analysed using descriptive statistics, ANCOVA and MCA.

The result showed; participants as comprising 217 (48.22%) males and 233 (51.78%) females; that the students were predominantly less than 15years old (87.56%); that the brainstorming strategies had significant effect on the students' achievement ($F_{(2, 449)}$ = 364.140, $p < .05$) and attitude ($F_{(2, 449)}$ = 259.381, $p < .05$) but that personality traits did not have significant effect on the students' achievement ($F_{(1, 449)}$ = 2.071, $p > .05$) but had significant effect on the students' attitude towards Basic Science ($F_{(1, 449)}$ = 29.235, $p < .05$); that gender had no significant effect the students' achievement ($F_{(1, 449)}$ = .122, $p > .05$) and attitude ($F_{(1, 449)}$ = .502, $p > .05$); that there was a significant interaction effect of the brainstorming strategies and personality traits on the students' achievements ($F_{(2, 449)}$ = 4.026, $p < .05$) and attitude ($F_{(2, 449)}$ = 30.281, $p < .05$); that there was no significant interaction effect of the brainstorming strategies and gender on students' achievements ($F_{(2, 449)}$ = .676, $p > .05$) and attitude ($F_{(2, 449)}$ = 2.196, $p > .05$); that there was no significant interaction effect of gender and personality traits on the students' achievement ($F_{(1, 449)}$ = .010, $p > .05$) and attitude ($F_{(2, 449)}$ = 2.263, $p > .05$) and that there was no significant interaction effects of the brainstorming strategies, personality traits and gender on students' achievements ($F_{(2, 449)}$ = .741, $p > .05$) and attitude to Basic Science ($F_{(2, 449)}$ = 1.381, $p > .05$) and that the Freewriting strategy effected higher improvement in students' achievement and attitude than the Questioning strategy.

It was concluded that the brainstorming instructional strategies enhanced the JSS II students' achievement and attitude but that the Freewriting strategy was more effective than the Questioning strategy and that low personality trait students (introverts) perform higher but with lower attitude score than the high personality trait students (extroverts).

It was recommended that these two strategies be adopted in teaching Basic Science in secondary schools in Osun State.

Keywords: Junior secondary school students in Osun state, Learning outcomes in basic science, Freewriting brainstorming instructional strategy, Questioning brainstorming instructional strategy.

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CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Education remains an instrument of change and national development worldwide and so Nigerian National Policy on Education (FME, 2004) declares that education is an "instrument per excellence" for realization of the goals. Science is also identified as a necessary factor for economic development of every nation (Ojebisi, 2010). In realization of this, National Policy on Education has provisions for quality science education for the citizenry. Good science education is a necessary factor in the effort to ensure quality science, therefore, Nigeria has been exerting tremendous and well-documented efforts to address problems confronting science education through reviews and reforms as necessary.

Basic Science, the form in which science is currently being taught at the JuniorSecondary School level in Nigeria evolved from Integrated Science through curriculum reform. The reforming of educational programme for human development and social responsibility in Nigeria is not just to access to a large number of Nigerians but also about developing critical competencies and knowledge for sustained growth (Obioma, 2005). Thereview of Integrated Science was necessary for effective improvement to achieve certain national objectives of education (Anekwe and Obi, 2009). Thus the evolved curriculum, Basic Science, would be expected among other things, to produce scientifically literate citizens (Offorma, 2005); improve nation's capacity to make use of new technologies (Maharjan and White,2000; Olatoye and Afuwape,2004); produce higher percentage pass of students in the subject at the end of Junior Secondary School programme (Keevesand Morgarstain,1992; Olatoye and Afuwape,2004), as well as improve enrolment in science related courses at the tertiary level. All these and more are to be accomplished if the gaps in the former Integrated Science are to be filled.

Basic Science is basic training in scientific skills required for human survival, sustainable development and societal transformation as explained by Nigerian Educational Research Development Council (NERDC, 2007). According to Obioma (2007) and Sodipo (2009), the new curriculum is to prepare the products to become effective citizens who will be self –reliant, confident, competent and globally competitive. The educational goal of Basic Science as set out by NERDC is not only to create future scientists but more importantly to produce Nigerian citizens equipped with understanding of science so that they are able to participate intelligently in critical thinking activities, problem solving and decision making process. In other words, students should be able to apply the content knowledge acquired to real world problems and to give evidence of more than superficial understanding of concepts and relationship that are fundamental to Basic Science. In fact, Omoifo (2012) explains the importance of effective teaching and emphasizes that effective teaching only occurs when students learn and achieve many scientific goals and not just being able to repeat scientific knowledge.

In order to achieve the laudable goals of the new Basic Science curriculum, some identified factors that militated against former Integrated Science should be removed. Some of the identified factors include, poor attitude of students to science (Iroegbu, 2000), students' lack of interest in science (Adepitan, 2003) and poor Mathematics background of students (Ogunleye,2009). Teachers have been identified as a major factor in curriculum implementation. Ajibola (2008) noted that lack of initiative, innovation, constructive mind and creative ideas of teachers are affecting proper implementation of Basic Science curriculum. The teaching method or instructional strategy adopted by the teacher affects students' achievement and attitude to science (Gbolagade,2009). Teacher-centered strategies which encourage memorization of facts are more often adopted by teachers. According to Onose,Okogun and Richard (2009), Omoifo (2012) and Omorogbe (2013), when teacher-

centered strategies are adopted in teaching, such methods are not interactive and may render the set objectives unachievable.

The implementation of Basic Science Curriculum took off in 2009/2010 academic session in OsunState and some teachers were introduced to the new curriculum through in-service training where the philosophy, content and methodologies of Basic Science were taught. The first Junior Secondary School Examination in Basic Science was taken in 2012 but there was no appreciable change in performance of students from the previous years when Integrated Science was taught as revealed in Table 1.1. The table shows that students' performance in Integrated Science (2006-2011) was not encouraging as the percentage pass at credit level and above was consistently just a little above50% but it could be better if some factors are addressed.

Table 1.1: Analysis of JSS Three Results in Integrated Science and Basic Science inOsun State (2006-2012)

Year of Exam Integrated Science	**No of candidates registered**	**No with Distinctions**	**%**	**No with Credits**	**%**	**No with Passes**	**%**	**No that Failed**	**%**
2006	46,552	2,870	6.2	21,348	45.9	20,078	43.1	1,895	4.1
2007	44,729	1,645	3.6	20,462	45.7	20,465	45.7	1,831	4.1
2008	41,008	1, 009	2.5	19,875	48.5	18,590	43.3	1,280	3.1
2009	48,991	1,236	2.5	22,655	46.2	18,670	38.1	5,761	11.8
2010	45,768	780	1.7	25,531	55.8	17,392	38.0	1,813	3.96
2011	51,640	8,576	16.6	17,883	34.6	19,342	37.5	2,057	3.98
Basic Science 2012	44,090	4,810	10.9	15,615	35.4	15,971	36.2	5,044	11.4

Source: Science and Technology section, Osun State Ministry of Education, Osogbo

One of the key factors considered to be important when talking about the development of science education in any nation is the teacher. According to Aina (2013), there are shortages of qualified science teachers in Nigerian schools, most are not professionally qualified and so even when they have the content knowledge, they may lack the methodology. In the opinion of Oladejo, Olasunde and Ojebisi (2011) many science teachers have been teaching for many years without upgrading their knowledge by going for in-service training and this is affecting their output.

The choice of appropriate teaching method by a teacher is key to successful learning. Hence, a number of innovative teaching methods have been developed and found effective in teaching science. Some of these strategies include Problem Solving (Adesoji, 2008); Co-operative Learning (Nwosu and Nnewi,1997; Agbayewa 2000; Ojo, 2003) Inquiry-Based Instructional Strategy (Ige and Arowolo, 2003); Jigsaw 11 Instructional Strategy (Olaniyi ,2009). Classroom observations are yet to reveal the use of these innovative teaching methods. The implication of this is that either the practicing teachers are not aware of such methods or they could not change their classroom practices acquired during training. Teachers, therefore, need to be updated on innovative teaching approaches so that the lofty goals of any new curriculum will be achieved as they are the most influential agents in teaching and learning process (Obioma, 2006). It is suggested by Oladejo et al (2011), that science teachers should use different strategies as there is no single universal approach for specific topic or class.

Students as the learners have important roles to play in the learning process for meaningful learning. Effective teaching and meaningful learning occurs when students learn and achieve many scientific goals and not just being able to repeat scientific knowledge (Omoifo, 2012). Some of the factors militating against meaningful learning by students have

been identified to include: home background (Adeogun, 2009), lack of interest, poor self-concept, poor study habits (Erinoso, 2004), gender factor (Ebere, 2006) and individual personality traits (Allport, 1935).

The attitude of students towards science determines and influence achievement. Attitude is described by psychologists as an expression of favour or disfavour towards a person, place, thing or event (Allport,1935) can be influenced by one's past or present (Wood, 2000). Attitudes are expected to change according to experience. According to Vogel, Bohner and Wanke (2014), attitude may influence the attention to object, subject or event, and can also guide attention. Therefore, unless a student is exposed to good science education, the attitude will be unfavourable.

The teaching method that is student-centered in which students can reflect, talk, discuss and are active participants in the class are more likely to accomplish the set goals of Basic Science. In support of discussion and debates in the class, Tate (2010) wondered at the situation where the teacher does all the talking while students are expected to keep quiet as unnatural to the brain. He also noted that when students have opportunities to share ideas among their peers without the fear of criticism or sarcasm, they will naturally improve their higher order thinking skill, thereby becoming self- regulated learners.

It is therefore necessary to study and focus on methods that may be employed in teaching Basic Science to improve not only students' academic performance and attitude but also help students to be effective citizens and capable of scientific and reflective thinking. Students should be able to give evidence of more than superficial understanding of concepts and relationship that are fundamental to Basic Science and be able to apply the content knowledge acquired to real world problems (Yoloye, 2004; Aina, 2013). One method which has proved successful at encouraging discourse in the classroom is Brainstorming (Delbecq and Vandeven, 1971; Armstrong, 2006; Adewale, 2008; Cain, 2013). This method is based

on the assumption that it is natural for students to give their opinions when the teacher is not highly authoritative.There have been researches in which brainstorming have been used in specific subjects and courses such as Essay Writing (Ferris and Hedgcok, 2005); Engineering (Seineg, 1995); Anatomy (Arburn , 1998); Mathematics (Adewale, 2008). Brainstorming as a teaching method is capable of promoting achievement in and attitude towards science.

Brainstorming is a creative teaching-learning technique designed to generate a large number of ideas for problem solving in a group or individually.Students can play off each other's ideas and say practically what comes to mind. Rich (2006) defined brainstorming as a technique for stimulating creativity in group or individual problem solving, consisting of a 'green-light' stage in which solutions are suggested, and a 'red-light' stage in which the ideas are evaluated. According to Rickards (1999), brainstorming is a student-centered teaching method in which both learner and teacher co-operate to learn. Brainstorming, as first popularised by .A.F. Osborn in the late 1930s was designed as a group technique to generate a large number of ideas for solving problems. Osborn (1963) proposed that groups could double their creative output with brainstorming.

The primary goal of brainstorming in teaching science is to help students focus on a topic, contribute to free flow of ideas, tap into students' prior knowledge, give all students a chance to express all their ideas, eliminate fear of failures so that the students are not only seen but also heard thus increasing achievement, improving learning attitude to Basic Science and enhance problem solving ability of learners. As an instructional method, brainstorming can encourage reflective thinking skill in students (Watson, 2012), tap also into individuality and creativity of students (Armstrong, 2006). Brainstorming is however guided by four basic rules as outlined by Osborn (1963). These are, focus on quantity, withholding criticism, welcoming of unusual ideas and piggyback on each others' ideas. The rules are intended to reduce social inhibitions among group members, stimulate idea generation and increase

overall creativity of the group (Corelle, 2004). Brainstorming is effective only when it follows the laid down rules and guidelines as laid down by the inventor, Osborn, 1963. The teacher serves as overall facilitator who defines the problem to be solved, provides adequate instructions on how to interact with materials supplied and gathers ideas that are generated.

Brainstorming couldbe carried out using different strategiesidentified by scholars toinclude Cubing, Freewriting, Questioning/Journalistic Questions, Mapping and Listing (Harris, 2002; Nichol, 2012, Tate, 2010). The importance of strategy in brainstorming is to remove such problems as distraction, social loafing, apprehension and production blocking. There are also variations of traditional brainstorming, such as Electronic brainstorming, Directed brainstorming, Brainwriting,Carousel brainstorming and Individual brainstorming. The choice of the strategy and variety of brainstorming for a particular lesson depends on the objective of the lesson. In this study, the effects of Freewriting and Questioning brainstorming strategies are used to elicit responses of students.

Brainstorming Freewriting strategy involves writing of ideas on a given topic without stopping or editing for a certain amount of time (Armstrong, 2006). The purpose of Freewriting is to push one's thinking further and to put down percolating ideas without hindrance. During Freewriting, grammar, spelling, organisation or language are not given consideration until the specified period is over. Thus the goal is quantity of ideas. The individual in Freewriting is howeverresponding to the instruction of the teacher.

Brainstorming Questioning strategy is a process of asking focus-directed questions such as why? Who? What? When? Where? and How? to which learners will respond as perceived but not under examination stress (Armstrong, 2006). The use of question as a strategy in teaching is one of the most potent tools for stimulating thinking, assess students' progress, motivate students to pay attention, provide repetition and emphasize key points (Davis and Linn,2000). In brainstorming, questioning is an indispensable tool and according

to Hyman (2003) and Risio (2006), questioning in brainstorming presents a challenge, provides an opportunity for students to express their ideas and thought; allow students to hear divergent opinions from fellow students, stimulate creativity, and develops confidence and feelings of success in the students which lead them beyond the conventional pattern of thinking.

Whatever strategy is used in brainstorming, the use of visual and auditory materialsare however, very necessary for structured learning. Such materials known as mind-prompting devices or block- busters (Corell, 2004)are useful in the introduction of a topic and to stimulate ideas. They enable learners to orientate themselves to the topic so that they can locate where any particular bit of input fits in and how it links with what they already know, give direction to students, organize their thought and capable of opening up discussion. Examples are a simple sentence, a concept or mind-map, poster on the wall, pictures, charts, diagrams, hand-out with spaces which students can fill and study guides (Arthur and Bethel, 1999; Harris, 2002). Researches in the teaching and learning of Sciences have shown much interest in the area of learning strategies in recent years, but very little research has looked at effectiveness of brainstorming as a learning strategy in the teaching of science subjects. The introduction of interactive teaching strategies to improve higher order thinking skill has been very slow. In order to encourage a discussion class in which no child is left behind, this study used Freewriting and Questioning as brainstorming strategies to teach Basic Science to Junior Secondary School 11 students in OsunState.

Issue of gender is relevant in this study even though the effect of gender on learning outcomes seems to be controversial. There is the general report of low participation of girls in science. Olagunju (2000) reports that there is a non-active participation of females in science and this constitutes a serious drawback in the national development process. The situation is alleged to be promoted by teachers who overtly express more confidence in boys and interact

more with boys during classroom discussion (Obianyo, 2000). In this way, boys and girls even in the same classroom acquire different learning experiences (Okeke, 1996). There is a need more than ever before for more female scientists in decision-making positions. A gender-inclusive teaching method is desired to develop understanding and respect for differences, learner participation and success in their learning (UNESCO, 2004). The use of brainstorming strategies where individual's idea is valued and respected could reduce gender inequality. Each individual (male or female) is allowed to talk without censorship, harassment or criticism. Oludipe (2012) in his review of the new 9-year Basic Education Curriculum attested to the inclusion of gender equity as a major issue for consideration in learning.

Personality traits of an individual can also not be ignored in this study because it influences how one learns or relates with others. In an interactive learning method such as brainstorming, its consideration is very crucial. Personality traits are dimensions of behaviour expression that are used to describe human characteristics. Personality traits serve as directors or blocks for motivation and individual learning strategies (Heinstrom, 2000). The Big Five Framework of Personality Traits (Openness, Conscientiousness, Extraversion, Agreeableness and Neurotism) as identified by Costa and Mcrae (1992) has emerged as a robust model for understanding the relationship between personality and various academic behaviours (Poropat, 2009), and all have implication for learning. The ability to generate ideas cannot be the same for all students and achievement will also not be the same. However, extraversion dimension has been identified as the central domain of personality traits (Poropat, 2009), and it is expressed on a continuum of extroversion and introversion. Extraversion dimension of personality trait is the only one considered for study out of the Big Five because everybody has a measure of it and its effect on the social atmosphere of the class can easily affect generation of ideas.

Extroversion-Introversion as a single continuum implies that to be high on one is to be low on the other. According to Jung (1995), everyone has both an extraverted side and an introverted side with one being dominant than the other. Extraversion is viewed as the act, state or habit of being predominantly concerned with and obtaining gratification from what is outside self while Introversion is the act, state or tendency towards being wholly or predominantly concerned with and interested in one's own mental life (Mayer, 2004). Generally, introverts tend towards reflection while their energy dwindle during interaction. In order to help each individual to benefit optimally from teaching, there is a need to find out how brainstorming affects the extraversion dimension of personality trait.

The main feature of brainstorming is generation of ideas. But generation of ideas by students may be hindered by mind blocks. Certain strategies have to be used to act as blockbusters. In this study, Freewriting and Questioning brainstorming strategies were used to remove blocks against idea generation. This study investigated the effects of Freewriting and Questioning brainstorming strategies on learning outcomes of Basic Science for JuniorSecondary school Two Students in OsunState. The influence of extraversion dimension of personality traits on learners, as well as gender on ability to brainstorm and come up with usable ideas for improved learning outcome in Basic Science were also investigated.

1.2 Statement of the Problem

Basic science as the basic training in scientific skills required for human survival, sustainable development and societal transformation is yet to achieve its role to prepare students to become effective citizens who are self-reliant, confident and globally competitive. This trend has been attributed to usage of ineffective instructional strategies by teachers. Therefore, scholars have suggested adoption of instructional strategies that are capable of

making students interact with one another and link their past experiences to generate new ideas.

It is a known fact that most teachers in Nigerian classrooms adopt methods of instruction which would not encourage students to play active role in the teaching-learning process. Therefore, students are often forced to learn by memorisation of facts, which usually result in poor performances in school and public examinations. In most cases also, students cannot apply the knowledge acquired in school to real world problems and only demonstrate superficial understanding of concepts. In order to fill this obvious gap, there is a need to adopt a teaching method which would prepare students for a future of effective problem-solving, thoughtful decision making and lifelong learning. Hence, the choice of Brainstorming, an approach which requires students to generate ideas and provide explanations on concepts at individual levels based on their previous knowledge and facilitated by brainstorming strategies, Freewriting and Questioning to remove blocks and hindrances to generation of ideas under the guidance of the teacher. .

This study therefore determined the effects of two modes of brainstorming strategies (Freewriting and Questioning) on achievement and attitudes of Junior Secondary II students in Basic Science. The influences of gender and extraversion dimension of personality traits of individual student were also investigated.

1.3 Hypotheses

The study tested the following null hypothesis at 0.05 level of significance.

Ho_1: There is no significant main effect of treatment on students'

(a) Achievement in Basic Science (b) Attitude to Basic Science

Ho_2: There is no significant main effect of Extraversion Personality traits on students'

(a) Achievement in Basic Science (b) Attitude to Basic Science

Ho_3: There is no significant main effect of Gender on students'.

(a) Achievement in Basic Science (b) Attitude to Basic Science

Ho_4: There is no significant interaction effect of treatmentandExtraversionPersonality traits on students'

(a) Achievement in Basic Science; (b) Attitude to Basic Science.

Ho_5: There is no significant interaction effect of the treatment and Gender on students'.

(a) Achievement in Basic Science (b) Attitude to Basic Science

Ho_6: There is no significant interaction effect of Gender and Extraversion Personality traits on students'.

(a) Achievement in Basic Science; (b) Attitude to Basic Science.

Ho_7: There is no significant interaction effect of Treatment, Gender and Extraversion Personality traits on students'Achievement in Basic Science (b) Attitude to Science

1.4 Scope of the Study

The study covered Junior Secondary School II students in Osun state, Nigeria. It involved three levels of treatment- Freewritingbrainstorming and Questioning brainstorming and the Conventional method as the control. The topics selected for study were those designed for the period as intact classes were used. The topics were under the themes Ecology, Energy and Sexually Transmitted Infections (STI) including HIV/AIDS.

1.5 Significance of the Study

Teaching of Basic Science through creative instructional method such as brainstorming would help students to have an early interest in intellectual activities such as the identification of problems, problem solving and transfer of knowledge to life situations if

adopted. It would help students acquire new skills for processing information and to develop attitudes of independence that may be carried over into new situation.

Acquisition of new skills for processing information through brainstorming will help each student to have an improved cognitive achievement, sound scientific literacy and better productivity in science if adopted. The improved learning outcomes of students would invariably affect both attitude of science teachers and the society as a whole. Teachers would be challenged to have adequate preparation for lessons and parents are more involved in knowledge sharing.

Findings of the study are expected to serve as part of many efforts made by educators in Nigeria to make the students and teachers collaborators in learning. It is expected that the findings from the study would improve enrolment of students for science subjects at senior secondary school and tertiary level. Furthermore, it is anticipated that the finding from this study would provide curriculum planners and teacher trainers with pertinent information in developing teaching methods using variety of brainstorming strategies. It would also give an insight into how best to teach for gender equality in Basic Science since everybody's opinion is expected to berespected regardless of gender. In addition, the results of this study would provide information on the extent to which personality traits influence the social atmosphere in the classroom and so improve class management by the teacher. It is also hoped that this study would be found useful to all stakeholders operating within the educational sector so as to build the desired scientifically literate generation of people who can think for themselves, study for achievement and for self-improvement both at school and in later life.

1.6 Operational Definition of Terms

Attitude to Basic Science: This is the **i**ndividual student's degree or dislike for learning Basic Science as expressed on the questionnaire on attitude provided.

Brainstorming Strategies: These are Freewriting and Questioning systematic plans intended to bring out original ideas from students in teaching Basic Science concepts.

Freewriting brainstorming strategy: This is a brainstorming strategy in which students are expected to write down their ideas on aconcept with a quantitative goal within a specified period without criticism, sarcasm or instant evaluation.

Questioning brainstorming strategy: This is a strategy in which the teacher asks deliberate and focused questions to motivate students to express their thinking during brainstorming session. It is used by the teacher to draw out information from students and to encourage contribution of ideas from the students.

Learning Outcomes: These are achievement and attitude to Basic Science,ability to take decision and high scientific literacy student possesses and can be demonstrated upon completion of learning experiences.

Conventional Teaching Strategy: This refers to the prevalent teacher-centered method used by teachers to teach Basic Science. The method will be used to teach the control class in this study.

Extraversion Personality Trait: This is one of the five domains of the Five Factor of personality traits. Extraversion is concerned with what is outside self. Extraversion has Introversion at its opposite polar end so that extroversion and introversion forms a single continuum and concerned about how people use their energy. Extraversion tends to be manifested in outgoing, talkative while introversion is manifested in more reserved and solitary life

Personality Traits: These are dimensions of behaviour expression that are used to describe human characteristics. The Big Five Personality Traits, that is, Openness, Consciousness, Extraversion, Agreeableness and Neuroticism have implication for brainstorming and it is an important variable in the study. The particular dimension of personality trait used in this study is extraversion which is central to all personality traits as everybody possesses a measure of it.

Block-busters/Mind-prompts: These are materials supplied by the teacher to facilitate brainstorming. They include pictures, models, question stems, posters that are relevant to the topic.

CHAPTER TWO

LITERATURE REVIEW

The review of literature covered the following areas:

2.1.0 Theoretical framework

2.1.1 Piaget's Theory of Human Cognitive Development

2.1.2 Dewey's Theory of Experience.

2.1.3. Trait Theory of Personality

2 1.4 Theory of Brainstorming

2.2.0. Conceptual Review

2.2.1 Curriculum Review in Science Education

2.2.2 Origin of Brainstorming

2.2.3. Process of Brainstorming

2.2.4 Conducting a Brainstorming session

2.2.5. Brainstorming in Teaching-Learning Process

2.2.6. Brainstorming Teaching-Learning Strategies

2.2.7 Personality Traits and Learning Styles

2.3.0 Empirical Studies

2.3.1 Freewriting Brainstorming Strategy and Students' Learning Outcome in Basic Science

2.3.2 Questioning Brainstorming Strategy and Students' Learning outcome in Basic Science

2.3.3 Conventional Lecture Method and Students' Learning Outcome in Basic Science

2.3.4. Gender and Students' Learning Outcomes in Basic Science

2.3.5. Extraversion Domain of Personality Traits and Students' Learning Outcome in Basic Science

2.4.0. Appraisal of the Literature Reviewed

2.1.0 Theoretical Framework

Educational curricula and teaching methods are changing. One component of the current redevelopment of all subject area curricula is the change in focus of instruction from the transmission curriculum to a transactional curriculum. In a traditional curriculum, a teacher transmits information to students who passively listen and acquire facts. In a transactional curriculum, students are actively involved in their learning to reach new understandings. This study was based on the constructivist approach to teaching and learning.

Constructivism is a view of learning based on the belief that knowledge isnot a thing that can be simply given by the teacher at the front of the room to students in their desks. Rather, knowledge is constructed by learners through an active, mental process of development; learners are the builders and creators of meaning and knowledge. Constructivism draws on the developmental work of Piaget (1977) and Kelly (1991). Twomey (1989) defines constructivism by reference to four principles: learning, in an important way, depends on what we already know; new ideas occur as we adapt and change our old ideas; learning involves inventing ideas rather than mechanically accumulating facts; meaningful learning occurs through rethinking old ideas and coming to new conclusions about new ideas which conflict with our old ideas. A productive, constructivist classroom, then, consists of learner-centered, active instruction. In such a classroom, the teacher provides students with experiences that allow them to hypothesize, predict, manipulate objects, pose questions, research, investigate, imagine, and invent. The teacher's role is to facilitate this process.

From the perspective of constructivism, learners construct knowledge based on what they already understand as they make connections between new information and old information. Students' prior ideas, experiences and knowledge interact with new experiences

and their interpretations of the environment around them. Research by Savery and Duffy (1995) suggests that learning how to use the constructivist theories involves many interaction between the content, the activity of the learner, and the goals of the learner. The knowledge-building process of a learner is driven by cognitive conflict. Cognitive conflict occurs for learners when they encounter and recognize discrepancies between what they already know and new persuasive information that brings their current understanding into question. These discrepancies cause cognitive tension requiring adjustment to reduce the discrepancies. In an attempt to resolve these discrepancies, students may construct new knowledge. Thus the resolution of cognitive conflict drives learning.

Based on the core ideas of constructivist learning theory, constructivist pedagogy proposes that instruction must take students' prior ideas, experiences and knowledge into account while providing opportunities for students to construct new understanding. Similarly, the instructor in constructivism has to adapt to the role of facilitator and not a teacher. While a teacher tells, a facilitator asks; a teacher lectures from the front, a facilitator supports from the back; a teacher gives answers to a set of curriculum while a facilitator provides guidelines and creates the environment for the learner to arrive at his or her own conclusion.

Brainstorming has a lot to derive from constructivism. The roles of the instructor and the learner are well defined for effective learning. The works of notable constructivists like Piaget (1977)and Dewey have direct implication for brainstorming as an instructional method. Brainstorming as a teaching-learning method, is supported by constructivists who recommend minds-on explorations that engage learners in thoughtful, reflective investigations that promote hypothesis and questioning. A collaborative association, which is promoted by constructivist, is the hallmark of brainstorming in which individual ideas are fused together in problem solving.

2.1.1 Piaget's Theory of Human Cognitive Development

Piaget (1896-1980) believed that what distinguishes human beings from other animals is the ability to do 'abstract symbolic reasoning'. Cognition which refers to the inner process and products of the mind that lead to knowing includes all mental activities that make their way into virtually everything human beings do. Piaget also claimed that major cognitive advances take place as children act directly on the physical world, discover the shortcoming of their current ways of thinking and revise them to create a better fit with external reality. In other words, the more the experiences a child has at inquiry, the better and sharper his/her thinking.

There are two major aspects of Piaget's theory:

i. the process of coming to know,

ii. the stages we move through as we gradually acquire the ability to know.

According to Piaget, these two aspects follow distinct increasingly sophisticated stages of mental representation that children pass through on their way to adult level intelligence. Piaget proposed that children move through four stages of cognitive development, which are sensory motor, preoperational, concrete operational and formal operational during which the exploratory behaviours of children are transformed into the abstract, logical intelligence of adolescence and adulthood.

The four stages of development as espoused by Piaget roughly correlated with age as follows:

i. **Sensorimotor stage** (Infancy). In this period (which has 6 stages), intelligence is demonstrated through motor activity without the use of symbols. Knowledge of the world is limited (but developing) because its based on physical interactions/experiences. Children acquire object permanence at about 7 months of age (memory). Physical development (mobility) allows the child to begin developing

new intellectual abilities. Some symbollic (language) abilities are developed at the end of this stage.

ii. **Pre-operational stage** (Toddler and Early Childhood). In this period (which has two sub stages), intelligence is demonstrated through the use of symbols, language use matures, and memory and imagination are developed, but thinking is done in a nonlogical, nonreversable manner. Egocentric thinking predominates

iii. **Concrete operational stage** (Elementary and early adolescence). In this stage (characterized by 7 types of conservation: number, length, liquid, mass, weight, area, volume), intelligence is demonstrated through logical and systematic manipulation of symbols related to concrete objects. Operational thinking develops (mental actions that are reversible). Egocentric thought diminishes.

iv. **Formal operational stage** (Adolescence and adulthood). In this stage, intelligence is demonstrated through the logical use of symbols related to abstract concepts. Early in the period there is a return to egocentric thought.

The formal operational period which is the final stage in Piaget's theory is the level at which children are expected to move beyond concrete experience, think abstractly, reason logically and draw conclusions from information available as well as apply all these processes to hypothetical situations

The Nigerian Junior Secondary School Two students, who are the subjects for this study, fall within the formal operational stage (12-17years). According to Piaget, a student at this stage is able to originate many of his own ideas and also has the ability to do reflective thinking. In addition, scientific thinking is rarely taught directly but through well planned science teaching. Thus, Piaget's formal operational children can be encouraged to be rational thinkers by engaging in brainstorming even though not all children can manifest the characteristics of the stage at the same age due to individual differences. When a problem is

presented to a group, individuals brainstorm to bring up ideas. In the course of the brainstorming process, each student is in control of his learning as he searches for information, interacts with materials, peers and facilitator to bring about meaningful learning that is more likely to lead to deeper and longer lasting understanding as proposed by Piaget. During this interaction process, students undergo accommodation and assimilation stages in the learning process. Even though Piaget did not use the word 'Brainstorming', he believed that a child is capable of dealing with a problem by gathering all relevant information through reflection and then making all the possible combinations of the variables that are relevant to the problem solving.

2.1.2. Dewey's Theory of Experience

Dewey stressed that learning is not the passive acceptance of knowledge which exists 'out there' but that learning involves learners engaging with the world. According to Dewey (1977b), people learn to learn as they learn since learning consists both of constructing meaning and constructing systems of meaning. Each meaning we construct, therefore, makes us better able to give meaning to other sensations which can fit into a similar pattern.He stressed further that educational experience should be continuous and it should be interactive. By continuity he means that the experience should lead towards more and more growth, and by interaction he means how an experience allows us to interact with the society and others, with our situation. Progressive education should device experiences that are both continuous and interactive (Dewey, 1997a).

Dewey further explained the importance of reflective activity in learning since the crucial action of constructing meaning is mental, as it happens in the mind. Teachers need to provide activities that engage the mind as well as the hands. One needs knowledge to learn as it is not possible to assimilate new knowledge without having some structures developed

from previous knowledge to build on. The more we know, the more we can learn. The relevance of this theory to this study thus lies in the fact that learners can explore their environment, reflect on situation and come up with testable idea. Dewey's idea that the purpose of education should not revolve around a pre-determined body of knowledge but the realisation of one's full potential for the greater goal, supports the use of brainstorming strategies for contribution of students' ideas to knowledge. The theory supports the view of brainstorming that students should be allowed to explore for more facts rather than what the teacher supplies. Education should not be seen as a place to gain content knowledge only but also a place to learn how to live. This requires that every student should interact with other students in the process of learning and also have the opportunity to take part in their learning (Dewey, 1997b).

2.1.3 Trait Theory of Personality

Personality has been conceptualized from a variety of theoretical perspectives, and at various levels of abstraction or breadth (John, Hampson, and Goldberg, 1991; McAdams, 1995). Each of these levels has made unique contributions to our understanding of individual differences in behavior and experience. However, the number of personality traits, and scales designed to measure them, escalated without an end in sight. (Goldberg, 1971).

Trait theory (also called dispositional theory) is an approach to the study of human personality. Trait theorists are primarily interested in the measurement of traits, which can be described as habitual pattern of behavior, thought and emotion (Kasin,2003).Traits are regarded to be relatively stable over time and differ across individuals, so that no two people can have the same matrix of character traits. Two notable trait theorists areAllport(1936) and Eysenck(1985).

The Trait theory suggests that individual personalities are composed of a number of broad dispositions called Traits which Allport and Odbert(1936) categorized into three levels. These three levels are central traits, secondary traits and cardinal traits. Central traits are ones that dominate the entirety of a person's life such that a person carrying the trait may even become synonymous with the trait such as honesty; secondary traits are seen only in certain circumstances to provide a complete picture of human complexity while cardinal traits dominate and shape a person's behavior. Eysenck (1992) added that the traits are result of genetic factors and they have different levels of arousal. Differences in behavior are results of differences in trait composition and this has defined different personality traits.

Personality traits are distinguishing qualities or characteristics that are the embodiment of an individual. They are one's habitual pattern of behavior, temperament and emotion (Allport and Oddert, 1936). Based on differences in trait composition, Recent studies have suggested the likelihood of an individual personality affecting their educational identity (Klimstra, 2012). There are too many trait, but in order to describe human personality, psychologists have evolved the **five-factor model (**Costa, P.T.Jr. and McCrae 1992**).**The five factors are **openness,conscientiousness, extraversion, agreeableness** and n**euroticism.** Beneath each global factor, a cluster of correlated and more specific primary factors are found. The Big Five model is able to account for different traits in personality without overlapping and has also been found across a wide range of participants of different ages and of different structures (Schacter, 2011). Personality plays an important role that affects academic achievement.

The importance of Trait theory cannot be underestimated in a brainstorming teaching-learning situation in which individual differences is at play. Ability to brainstorm will vary, the quantity of ideas produced will differ and the extent or quality of interaction contributing ideas to problem- solving will also be affected by the personalities involved.

2.1.4 Theory of Brainstorming

Alex Faickney Osborn, (May 24, 1888- May 5, 1966) is regarded as the father of creativity and Brainstorming (Chae, 1997). His core belief in creativity and brainstorming is that human beings have the capability to be creative and it is just a matter of deliberately accessing it through a method he called brainstorming. His main theory is that members of the group will be stimulated by each others' ideas to come up with new suggestions and out of the multiple ideas, one or more will be a good solution for the problem. He published many books and organized many seminars to explain his theory of creativity and brainstorming. Some of the books include; Wake Up Your Mind: 101 Ways to Develop Creativeness (1952); Your Creative Power-How to use Imagination (1952) ; How to Become more Creative (1964) and A source book for Creative Thinking (1964).

Osborn's main assumptions:

- Everybody has creative power;
- People should be conscious of their creative power;
- Group brainstorming is a potent method to access one's creative power;
- We need to think up many tentative ideas because in ideation, quantity helps bring quality.

In order to remove inhibitions to idea generation in a group, Osborn (1941) providedprinciples and ground rules to guide operation of brainstorming. The principles and ground rules were formulated to give people the freedom of mind and action to spark off and reveal new ideas by "thinking up". The principles are:

- Defer judgment
- Reach for quantity.

The principles define the focus of the process which aims at producing as many ideas as possible from which to choose. The ground rules were also stated in line with the principles and with the intention to reduce social inhibitions among group members, stimulate idea generation and increase overall creativity of the group. These are:

1. **Focus on quantity**: This is a means of enhancing divergent thinking.

2. **Withhold criticism**: by suspending judgment, participants will feel free to generate unusual ideas as there in no limit to what they can contribute within the stipulated time.

3. **Welcome unusual ideas**: In order to get a good and long list of ideas, unusual ideas are welcomed..

4. **Combine** and improve ideas: this is also called "piggybacking" whereby ideas are built by associations. Good ideas may be combined to form a single better good idea.

Osborn notes that brainstorming should address a specific question because sessions addressing multiple questions are inefficient. He laid emphasis on group working together. The theory of brainstorming as postulated by Osborn still holds in all its process but more recent researches have refuted Osborn's claim that group brainstorming could generate more ideas than individuals working alone (Diehl and Stroebe1991). Some of the factors identified to contribute to productivity loss in group brainstorming include blocking,collaborative fixation, evaluation apprehension, personality characteristics, social matching and free-riding. Numerous attempts have been made to improve brainstorming or use more effective variations of the basic technique such as Individual brainstorming, Directed brainstorming, Electronic brainstorming and Carrousal brainstorming. Many strategies and variations have also evolved and evolving. Although traditional brainstorming does not increase the

productivity of groups, it provides other benefits such as boosting morale, enhancing learning environment and improving team work.

2.2.0. Conceptual Review

2.2.1. Curriculum Review in Science Education

The historical antecedent of curriculum development in Nigeria began with the arrival of Christian missions in 1842 and the establishment of missionary schools. Some of the subjects taught science in form of Nature Study.

Science Education reforms which connote Science Development efforts began with the birth of Basic Science for Nigerian Secondary Schools (BSNSS) undertaken at the Comprehensive High School, Aiyetoro. This was followed by the Nigerian Integrated Science Project (NISP) championed by Science Teachers Association of Nigeria (STAN). The involvement of government ministries saw the emergence of Nigerian Educational Research and Development Council (NERDC). The purpose of the curriculum reform efforts hinged on the fact that there were total dissatisfaction with how science was traditionally being taught.

This traditional approach, as noted by Ojimba (2013), is related to the decreasing popularity of science among students as evidenced by the number of students choosing science-related courses at tertiary institutions. In addition, the traditional approach, it was argued did not adequately prepare future citizens to understand science and technology issues in a rapidly evolving society. Kennedy (2000) suggested that instead of transmitting content knowledge in a rigid manner, the emphasis in teaching should be on designing situations and a variety of activities which enable students to learn actively. In this respect, the teacher needs to investigate what the student already knows, identify possible misconceptions and

then design an appropriate educational setting. Hence, the introduction of new 9-year Basic Education Programme.

According to Obioma (2007), the decision of the Federal Government of Nigeria to introduce the 9-year Basic Education Programme is to attain targets of the Millennium Development Goals by the year 2015 and the critical targets of the National Economic Empowerment and Development Strategies Needs for value re-orientation, poverty eradication, job creation and wealth creation. If the vision is to be realized Science and Technology are essential tools (Tahir,2005).

The Basic Science Curriculum evolved for JuniorSecondary School class is a re-aligned and re-structured form of Integrated Science. The shift in curriculum now emphasizes reflection on science rather than focusing solely on the content of scientific ideas so as to teach science in a way which appeals to all students from a cognitive and affective perspectives. Mill and Osborne (1998) suggested a shift towards the teaching of inquiry skills which is of more value than the traditional method.

2.2.2. Origin of Brainstorming

According to Osborn, (1941) brainstorming is a group technique to create new ideas. It is a group creativity technique designed to generate a large number of ideas for solution to a problem. The method was first popularized by Alex Osborne, an advertising agent, as an activity for people in a group to generate ideas to solve a common problem. In his book, Applied Imagination, Osborn (1963), proposed that groups could double their creative output with brainstorming. He discovered that groups usually come up with better advertising strategies that improved sales of products. The group takes a specific problem and creates as many ideas as possible in a limited time. In a Brainstorming session, it is expected of every group member to speak out all ideas that come to his/her mind, no criticism is allowed, and

the wilder an idea the better. Members are encouraged to use other members' ideas as trigger (input) to create/associate further ideas, and to combine ideas.

Brainstorming can therefore be used to solve all kinds of problems (business, public administration, military, education, scientific, family, personal). It is important to have a problem that is specific and can be made into a question. It is very relevant when:

- A specific problem/challenge expressed as a question.
- A group of between 5 and 10 people. We want a mixed group of men and women, experts and non-experts. The group can contain the president, managers, workers, cleaners... Everyone might have ideas that can help to solve the problem.
- A leader who ensures that a few basic rules are followed.

How to Brainstorm?

1. The leader or another member introduces the problem. The problem is expressed as a question (this can be done before the class, or as first step in the classroom)
2. The problem is explained in a way that all group members understand the problem.
3. Some facts/details of the problem are provided before brainstorming session starts. A field trip or visit to the place where the problem occurs can help the group members to see and understand the nature of the problem.
4. The group meets in a half circle and starts to storm the problem. Everyone just speaks out his/her ideas. All ideas are welcome, simple ideas, crazy ideas…. The more ideas, the better. No group member, including the leader is allowed to criticize any idea. Everyone is encouraged, to use other group members' ideas to come up with yet another idea.
5. All ideas are recorded by a note taker (can be the leader or another person) at a place where all group members can see the ideas. The easiest way is to record the ideas in

form of a list on a flip chart or white board. We don't note ideas word for word but try to use keywords or short phrases.

Osborn (1941) described Four Basic Rules of brainstorming

1. No criticism is allowed during brainstorming. (Evaluation of ideas after the brainstorming)
2. Quantity is important. The more ideas the better. (Don't worry about speaking out only "good" ideas.)
3. Wildness is good. Crazy ideas are welcome. (Many times the craziest ideas turn out to be the best ones)
4. Combining other ideas and taking another person's ideas a step further or using them for yet another idea is good.

A brainstorming session lasts between 30 minutes and 1 hour. After the meeting, the list of ideas is copied and distribute to all group members. A good way to copy a whiteboard or flip chart is to take a picture with a digital camera.

Osborn (1964) described brainstorming as a structured team decision-making process whereby team members interact to generate as many ideas as possible to solve identified problem. This as a process is based on the premise that most problems are not solved automatically by the first idea that comes to mind, so to get the best solution, it is better to consider possible options.

The use of brainstorming at finding workable solution to problem was later found to be useful in other fields of endeavour. Brainstorming was reported by Burt (1964) to have grown to the extent that it is widely used by professional groups and also by teachers in the classroom.

2.2.3. Process of Brainstorming

Brainstorming technique typically involves gathering a group of up to ten people, including invited guests from other fields, posing a question and asking them to respond with as many answers as possible. Their responses are recorded and later sorted out and evaluated.The steps involved in brainstorming were outlined by Osborn (1963):

i. Define Problem: the problem to be solved is well-defined. It must be clear, not too big and captured in a specific question.

ii. Select Participants: The facilitator composes the brainstorming panel. A group of 10 or fewer members is generally considered more productive. An idea recorder is selected.

iii. Provide activities and materials to stimulate creativity.

iv. Explain ground rules including the time allowed.

v. the facilitator leads the brainstorming session according to method adopted.

vi. Evaluation of ideas: The facilitator encourages discussion for evaluation of ideas.

Challenges to effective brainstorming

A good deal of research refutes Osborn's claim that group brainstorming could generate more ideas than individuals working alone . Diehl and Stroebe(1991) reviewed 22 studies of group brainstorming as outlined by Osborn and found out that groups brainstorming together produce fewer ideas than individuals working separately. Several factors were found to contribute to a loss in effectiveness in group brainstorming. These include: blocking, collaborative fixation, evaluation apprehension and personality characteristics. Blocking occurs if an individual does not have time to contribute idea as at a time one is ready. The time- lag may inhibit a person's train of thought in generating their own ideas and remembering it (Haddou, Camilleri and Zarate, 2014).

Collaborative fixation occurs when members conform their ideas to those of other members, decreasing the novelty or variety of ideas (Kohn and Smith, 2011).

The fear of judgement on a person's ideas may cause evaluation apprehension (Diehl and Stroebe, 1991), while some individuals may feel that their ideas are less valuable when compared with the ideas of the group at large (Diehl and Stroebe, 1991). This leads to free-riding. Personality factors affect output of a group. Extraverts have shown to outperform introverts in computer mediated groups (Henningsen and Henningsen, 2013).

The factors have led to the use of individual brainstorming more often than group and in some cases they are combined. While brainstorming as defined by Osborn is often regarded as Traditional Brainstorming, the modified brainstorming that takes the highlighted problems into consideration is now regarded as Advanced Brainstorming (Rickards 1999; Harris, 2002; Henningsen and Henningsen, 2013).

2.2.4. Conducting a Brainstorming Session

The brainstorming session is the stage of idea generation. It begins with the understanding of the ground rules. Osborn (1963) outlined four basic rules for brainstorming. The ground rules are intended to reduce social inhibitions among group members, stimulate idea generation and increase overall creativity of the process. One of the rules is *Withhold criticism.* When criticism is suspended till another critical stage of the process, participants will feel free to generate crazy and unusual ideas which result in better solution. Another rule is to *Focus on Quantity.* The assumption is that the greater the number of ideas generated, the greater the chance of producing a radical and effective solution to the problem being discussed. The third rule, *Piggyback ideas,* encourages team members to combine and improve on the ideas already presented. Brainstorming is believed to stimulate the building of ideas by a process of association, that is, good ideas may be combined to form a single even

better good solution. The forth rule, *Encourage freewheeling,* deals with welcoming wild and strange ideas. Participants are encouraged to look for new perspectives and suspend assumptions. Such a way of thinking is the seed of divergent thinking in the creative process.

Brainstorming sessions are being modified as researches on its conduct progresses. Rickards (1999), suggest a warm-up session after presentation of ground rules so as to expose novice participants to criticism-free environment. The use of mind-prompts was added (Armstrong,2006), the choice of appropriate strategy was considered essential and the choice of individual brainstorming over group brainstorming became prominent. Fig 2.2 gives an idea of how brainstorming should be conducted effectively.

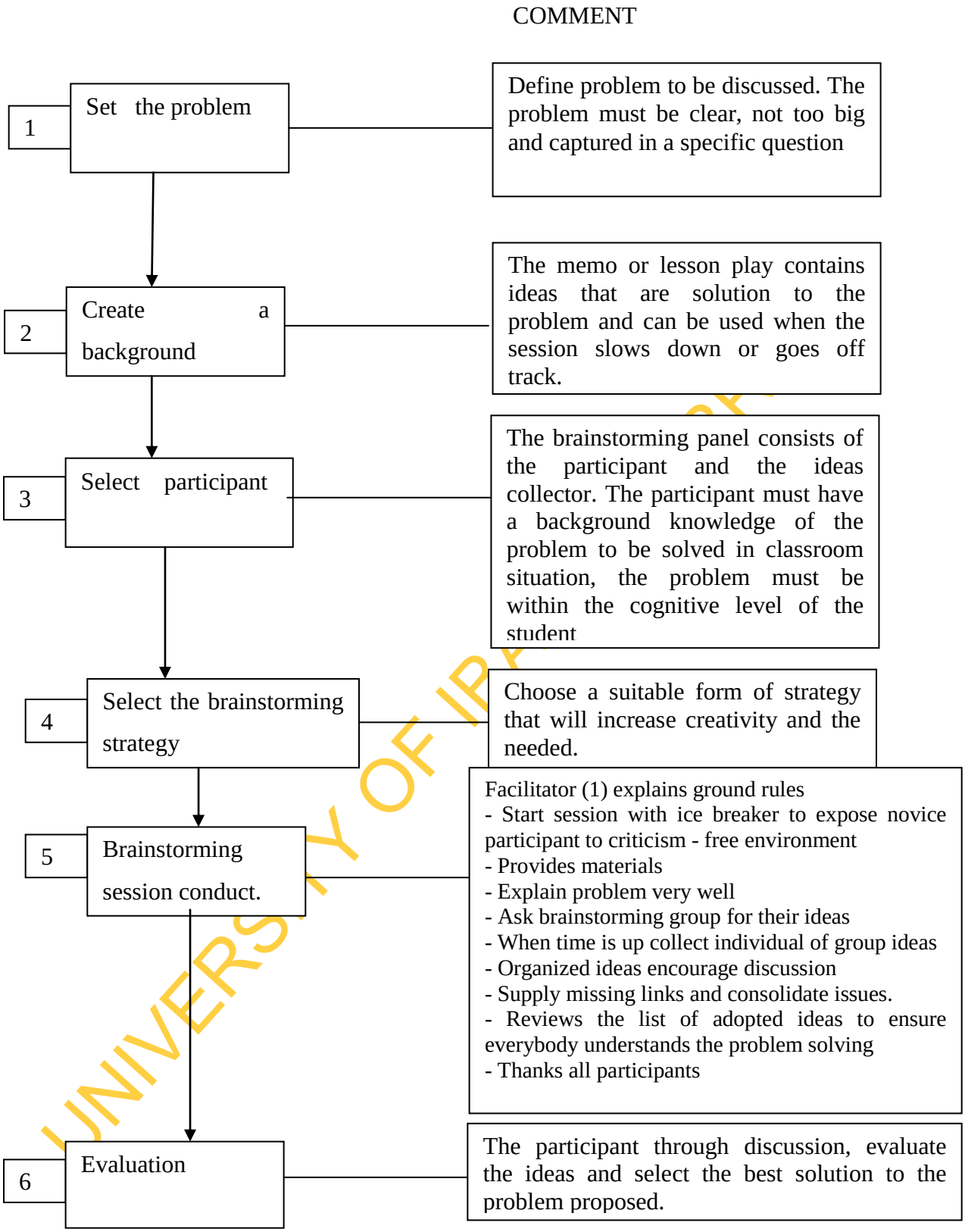


Fig. 2.1. Osborn's method of Brainstorming

2.2.5. Brainstorming in Teaching-Learning Process

Brainstorming was defined by its inventor, Osborn (1953) as a creative technique by which efforts are made to find solution to a specific problem by gathering a list of ideas from members of the group. Osborn further claimed that two principles contribute to" ideative efficacy" which are deferment of judgment and reaching for quantity. Based on the principles, some rules were also put in place to reduce social inhibitions among group members and stimulate idea generation. In the view of the constructivists, brainstorming is a worth-while instructional strategy since it encourages students' participation and contribution.

The importance of brainstorming in teaching-learning process as explained by Cotton(1991), is to encourage students to engage in careful reflective thought. This ability has been viewed as a fundamental characteristic of an educated person, as a requirement for responsible citizenship in democratic society and more recently, as an employability skill for an increasingly wide range of jobs. The main goal of brainstorming as thus explained is to help individual leaner to construct knowledge by expanding his own knowledge base through various activities while the teachers provide conditions for various experiences to stimulate thought in the right direction.

Rich (2006), in his own contribution to importance of brainstorming technique in teaching-learning process asserted that it will push a class to a higher level of cognition, build in the students a concept of hard work, research and teamwork. It helps students reach lofty goals without filtering their ideas or inserting negative thoughts. According to Bach (2007), the world desperately needs problem solvers and so brainstorming is a valuable skill to learn.

Brainstorming session is not a random activity but rather guided by some principles which the teacher must follow to avoid chaos. Provision of effective mind prompts such as diagrams, short story, pictures, models are desired. Davis and Linn (2000), however warned that not all mind prompts result in knowledge integration while some can even derail knowledge if not

appropriately selected and presented. There are also various strategies to choose from for effective brainstorming. The choice of appropriate strategy will infuse creativity.

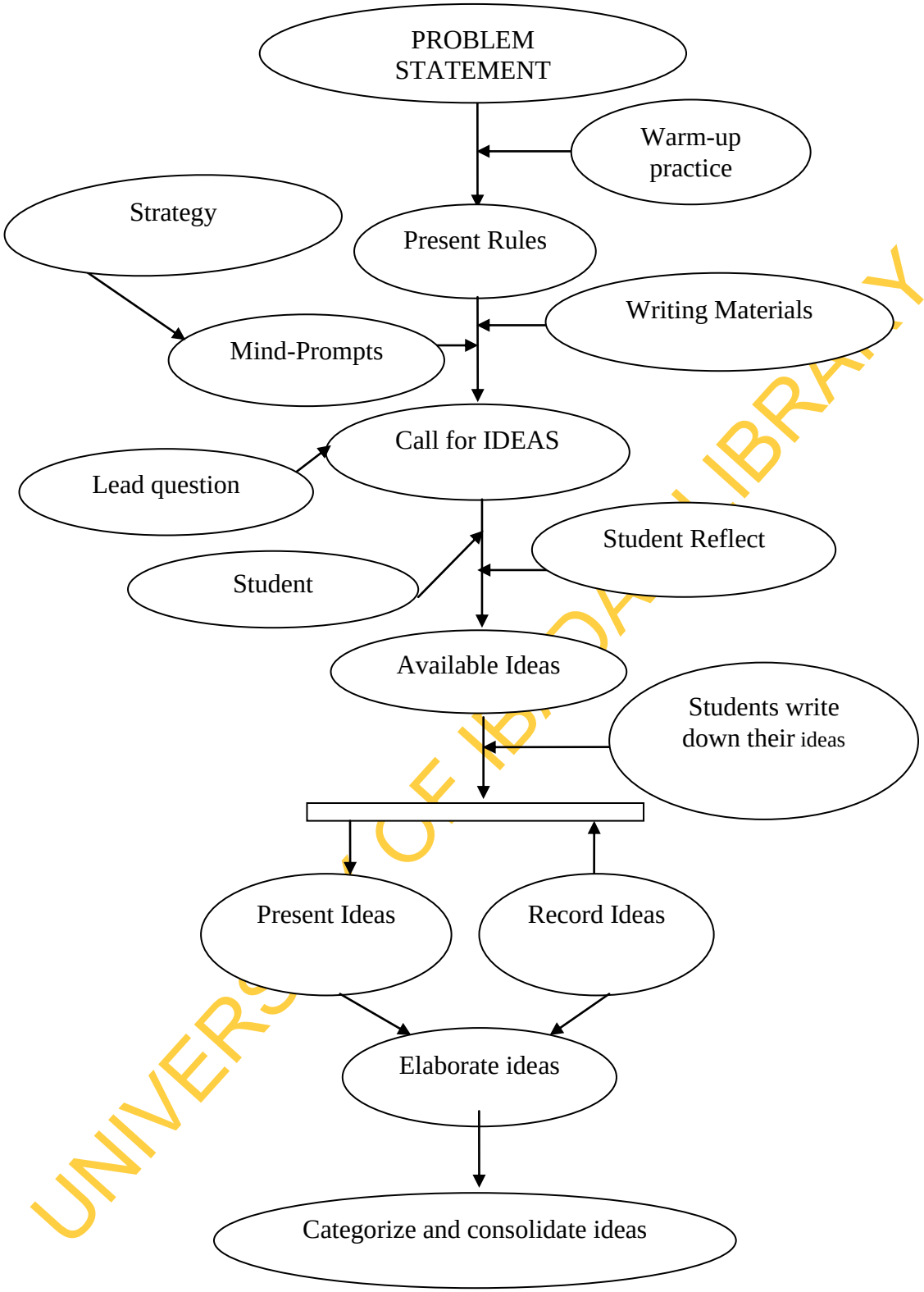


Fig 2:2.Advanced Process of Brainstorming. (Richards, 1999)

2.2.6 Brainstorming Teaching-Learning Strategies

Brainstorming instructional strategies are the planned activities by which idea generation could be facilitated. Harris (2002) contended that to break existing mindset and internalize abstract concept is not an easy task for children, teachers must therefore enrich the learning environment expecting students to generate ideas as expected in brainstorming on the basis of extraction is unrealistic and so Dewey (1905) prescribed that idea should be rooted in concrete experiences. The fear that students may not participate in idea generation, learn sufficient content or may not use higher order thinking could be overcome through supportive, intellectual and emotional environment that encourages students to take risks.

Some brainstorming strategies that have been identified include: scratch outline, questioning, word-map, freewriting, listing, mapping and researching. The choice of appropriate strategy depends on the topic of lesson and the ingenuity of the teacher as the facilitator. Brainstorming method may sometimes underdeliver without adequate preparation (Akinboye, 2007). Whatever strategy is adopted must be implemented in compliance with its fundamental issues as outlined by its inventor (Isaksen and John, 2011). The advocates of brainstorming at any course of a lesson suggested the use of freewriting and questioning strategies (Armstrong,2006; Nichol, 2009; Fleming,2013). Questioning brainstorming strategy has been described as fundamental to brainstorming (Harris,2002), while freewriting strategy became popular when individual brainstorming started being favoured in preference to group brainstorming (Armstrong, 2006) and it has been found effective.

2.2.7 Personality Traits and Learning Styles

The personality of an individual is the person's distinctive qualities or characters as determined by trait composition. Traits, definedashabitual patterns of behavior, thought and emotions (Kasim, 2003) are relatively stable over time, differ across individuals and

influence behavior. Psychologists like Digman (1990) and Goldberg (1993) have used identified central traits to propose a 'Five Factor Model' of personality. At least four sets of researchers have also worked independently for decades and have identified the same Five Factor Model. These Five Factor Model, so also known as The Big Five are namely Openness to Experience, Conscientiousness, Extraversion, Agreeableness and Neuroticism.

In contemporary psychology, the Five Factors are five broad domains or dimensions of personality that are used to describe human personality. The personalities have different learning styles. Scientists have defined four types of learning styles which are: Synthesis-Analysis, Methodical Study, Fact retention and Elaborate processing. Personality traits are expressed in learning styles which are in turn reflected in learning strategies which eventually produce a certain learning outcome (De Raad and Schmwenburg,1996). Learning styles serve as director or blocks for motivation and learning strategies.

According to the research carried out by Komarraju, Karau, Schmeck and Avdic (2011), neuroticism was negatively related with the four. Furthermore, extraversion and openness were only positively related to elaborative processing for questioning and analyzing arguments. Myers-Briggs (1996) asserted that when the learning style of students is compatible with their personality, students tend to retain information longer, apply learning more effectively, learn more and have amore positive attitude towards the subject.

2.3.0. Empirical Studies

Issues relating to basic science are so wide, diverse and multi-facetted and different researchers have delved into some of the related areas in their attempt to solve numerous challenges being faced by secondary school students in basic science. Forthis study to peruse some of such works with a view to identifying those areas that has a missing gap and to what extent this study has been able to fill the gap and contribute to knowledge.

According to Oludipe, (2008), what has remained the main focus of great concern in the field of science education are the biases and misconceptions about women and science, i.e. Science is a male enterprise.Franken (1994) in his research work states that self-concept is the basis for all motivated behavior, because it gives rise to possible selves and it is possible selves that create the motivation for behavior. Academic self-concept is one aspect of self-concept because it relates to how well students do in school or how well students learn. Byrne (1990) showed that academic self-concept was more effective than academic achievement in differentiating between low-track and high-track students. Self-concept encourages students or learners to develop in the study of Basic Science and this will provide necessary information for provoking inquisitive spirit of secondary school students.

Kolawole,(2007),Afuwape and Oludipe, (2008) found outthat there are significant differences in the cognitive, affective andpsychomotor skills of students in respect of gender while other researchershave provided reports that there are no longer distinguishing differences inthe cognitive, affective and psychomotor skill achievements of students inrespect of gender (Bilesanmi-Awoderu,2006)

Pandian (2004) investigated the effects of cooperative computer-assisted learning method on male and female students' achievement in biology. The students were randomly grouped into cooperative computer assisted learning and traditional method groups. The analysis of results indicated that gender did not expressany significant influence on biology achievement. However, male and female students in the cooperativecomputer-assisted instruction group showed remarkable post-test mean differences over their respectivecounterparts who learned the same biology concepts through traditional method.

Samuel and John (2004) examined how the cooperative class experiment (CCE) teaching methods affect students' achievement in Chemistry. They found that there was no significant difference in gender achievement between the experimental and control groups,

but girls had a slightly higher mean score than boys did. More so, the girls taught through CCE method performed better than girls taught through the conventional teaching method in the post-test scores. Similarly, boys who were taught using CCE method performed significantly better than the boys in the control groups in the post-test scores. The researchers also pointed out that there was no significant difference in achievement between boys and girls exposed to CCE method, both performed significantly better than those taught through conventional lecture method.

2.3.1 FreewritingBrainstorming Instructional Strategy and Students' Learning Outcomes

The process of Freewriting occurs when one writes down whatever comes to mind with a quantitative goal during brainstorming. During the process, the participant does not bother about coherence, spelling or grammar but just continue to write and "get the juices flowing" (Armstrong, 2006). The strategy is used by individuals.

Freewriting is helpful to uncover thoughts and feelings surrounding a topic, may help one to remember long-forgotten experiences and ideas which guide one towards mastery of topic and can also help one to formulate ideas. The fact that a participant is allowed freedom of expression without criticism or censorship and writes with the inner editor turned off, makes it a worthwhile brainstorming strategy for any subject (Nichol, 2011).

The advantages of brainstorming freewriting strategy were expressed by Watson (2012) to include elimination of fear of failure, a chance for all students to express their ideas, individuality and creativity are encouraged and there is a show of respect for everyone. After the brainstorming session, the teacher is provided with a great deal of information regarding what the students may or may not know. However, Fleming (2013) cautioned teachers to be aware of the fact that students have different learning styles, some may be uncomfortable

spilling thoughts on paper and may prefer expression of ideas in pictures, graphs or maps and some may not have anything in store to write. Teachers should therefore be flexible.

2.3.2. Questioning Brainstorming Instructional Strategy and Learning Outcomes

Questioning is a process of asking questions and expecting answers to the question. A question refers to any sentence regardless of the grammatical form intended to elicit an answer. An answer is any response that fulfils the expectation of the question (Caesin, 1995). One of the major jobs of a teacher is to promote thought and inspire inquiry in students. One effective way that has been found to achieve the task is through questioning (Cotton, 1999; Caram and Davis, 2005).

The use of questions to improve students' ability to think critically has been in use since the time of Socrates. Adequate and relevant question puts learners in a state of disequilibrium between the world outside and their inner mind. This state could force the student to brainstorm into resolving a problem (Arthur and Bethel, 1999). Well-created questions can assist students in digging deep for thoughtful responses because skilful questioning leads students to make their own discovery and create their own learning (Mckenzie, 1997).

The main purpose of questioning strategy in brainstorming is to stimulate thinking in the right direction. Casein (1997) asserted that the most important thinking requires one of the three prime questions, WHY, HOW, and WHICH. He explained further that WHY is the basic tool of constructive learning, HOW is investors' favourite question and basis for problem solving while WHICH requires thoughtful decision making for a reasoned choice. The WHAT, WHEN and WHERE questions are also important for a full report.

Questioning are to induce covert mental operations like identifying, differentiating, analyzing which will lead to visible activities such as classification, listing, predicting and

ideas shared. When the ground rules of brainstorming as stipulated by Osborn (1963) such as allowing everybody to contribute , no criticism, emphasis on quantity of ideas and ensuring that no one insults, demeanor prematurely evaluates others' responses, there was improvement in learning outcomes (Akinboye,2002; Harris, 2002). Questions have also been considered a potent strategy of brainstorming by Criz and Miller (2002), Kerr and Burr (2003) who discovered better comprehension from their studies.

2.3.3. Conventional Lecture Method and Students' Learning Outcomes

Conventional method of teaching is the traditional method of teaching in which the teacher dominates the lesson. It involves oral presentation of what is to be learnt by the teacher, generally leaving the students passive. It is regarded as the best way to transfer the teachers' notes to the students' notebook without necessarily passing through their mind as it contributes minimally to conceptual understanding of school science.

The Lecture method is not without its strength in teaching and learning. It is efficient in passing more information to students quickly, useful for initiating a lesson, summarizing the main points in a lesson or for providing knowledge to students in a group (Erinosho, 1997).

2.3.4. Gender and Students' Learning Outcomes in Basic Science

There are conflicting reports as regards the effect of gender on achievements. While some researchers (Opyene and Okemit, 1995; Fakorede, 1999) claim that male students have higher achievements than female students, some others claim discovered that females do well and sometimes record greater achievement in science (Yoloye, 2004). Studies have also shown significant differences in favour of boys (Bilesanmi-Awoderu,2002; Aremu, 2005; Abiona,2008; Ojo,2009), sometimes in favour of girls (Yoloye,2004; Olatundun, 2008) and sometimes no significant difference (Owoyemi, 2007; Oduwaye, 2009; Okoye, 2010).

The issue of gender is an important one in Science Education especially with increasing emphasis on ways of boasting manpower for technological development as well as increasing the population of female in Science and Technology fields (Ogunkola and Bilesanmi-Awoderu, 2002).

However, it has been reported that there is low presentation of females in science and technology disciplines which is an indication of low achievement in SeniorSecondary School examinations (Ogunleye,1999).

A lot of factors have been advanced for the advanced differences in achievement between boys and girls. Balogun (1994) explained that the differences are derived from various factors including bicultural model. This model explains that females generally see themselves in terms of their feminine roles of cooking, taking care of children and prefer to stay within profession that favours these roles. In the opinion of Adesoji (2002), there are biological, social and psychological reasons for the differences in achievement. Aremu (1998) identified the conformist attitude of girls as an underlying cause since girls rarely take risks as opposed to boys who tend to challenge status quo.

2.3.5. Extraversion Domain of Personality Trait and Students' Learning Outcomes

Extraversion is one of the Big Five Factors that describes personality traits. It is considered as the central dimension of personality trait. It was also described as the most recognizable personality trait of the Big Five (Pappas,2013). A person might have a dash of openness, a lot of conscientiousness, plenty of agreeableness, almost no neuroticism at all but there would always be a measure of extraversion.

Extraversion as a domain was first popularized by Jung (1921) to explain different attitudes people use to direct their energy in any activity. According to Heinstrom (2000), the quantity of information acquired by extraversion depends on the level of interaction and the level of extraversion. Extraversion is generally viewed as existing as part of a continuum

along with introversion. Extroversion indicates one end of the scale while introversion is at the other end.Some psychologists now put Ambiversion to fall more or less directly in the middle.

Psychologists have worked extensively on extraverts and introverts and discovered that while extraverts enjoy being with people and are often perceived being full of energy, introverts seem quiet, low-key, deliberate and less involved in the social world (Pappas, 2013). The difference in outlook will affect attitude and achievement.

2.4.0 Appraisal of the Literature Reviewed

Literature revealed that brainstorming strategies engage students in higher order thinking skills which significantly affected their critical thinking performance. Brainstorming freewriting and questioning strategies reviewed are educational tools that make students active participants in the class and provided opportunity for problem solving.Studies on brainstorming in teaching and learning of Basic Science were examined in the review. It was observed that majority of the studies were conducted in disciplines other than those of science, such as pre-writing, reading and comprehension. The review was devoid of an empirical base for using brainstorming strategies in teaching and learning of science in Nigeria. This has necessitated the need to adopt the model to focus primarily on the effectiveness of brainstorming strategies, Freewriting and Questioning, on the teaching of Basic Science concepts.

The review submitted that to achieve the Millennium goal to meet the global purpose of education, education must not only make learners more successful in the various subjects they study at the secondary level but be dynamically relevant in the society and also be a problem solver. It is necessary to look for an instructional strategy that will encourage creative and critical thinking and hence problem solving. Different teaching strategies have

been experimented with by researchers but the use of Brainstorming, a creative teaching strategy has not been examined fully, especially in Basic Science, but more commonly in essay writing, reading and comprehension.

Though questioning strategy is not new in teaching- learning situations, it is more often used for drilling students rather than promote thinking. Instructional aids in various forms have alsolong been in use more as teaching aids rather than learning aids. There is conflicting reports of the influence of gender on the learning outcomes in science, therefore it is included as a variable for presentinvestigation. Personality trait is a variable that can affect the learning style of individual and there is a need to investigate the domain of personality trait that is favourably disposed to Brainstorming. This is why in this present study, the researcher makes an empirical study on the effect of two modes of brainstorming strategies- Freewriting and Questioning, on the learning outcomes of students in Basic Science in Osun State.

CHAPTER THREE

METHODOLOGY

This chapter presents the research design, variables in the study, selection of participants, instrumentation, research procedure and method of data analysis.

3.1 Research Design

The study employed the pretest-posttest control group, quasi-experimental design using a 3x2x2 factorial matrix.

The design is symbolically represented below;

E_1: O_1 X_1 0_4

E_2 : O_2 $X_2 0_5$

C : O_3 X_3 0_6

Where:

E_1 represents the Brainstorming with FreewritingTeaching Strategy

E_2 represents the Brainstorming with Questioning Strategy

C represents the Control treatment of Conventional Teaching Strategy

O_1 O_2 0_3 represent Pretest measures of E_1, E_2 and C respectively

O_4 O_5 O_6representpostest measures of E_1, E_2 and C respectively.

X_1, X_2 and X_3 represent the treatments, X_1 is the Freewriting brainstorming strategy, X_2 is the Questioning brainstorming strategy and X_3 is the Conventional lecture method.

3.2 Variables in the Study

a. Independent Variables

These are the modes of instruction at three levels.

i. Freewriting Brainstorming Strategy

ii. Questioning Brainstorming Strategy

iii Conventional Teaching Strategy

(b) Moderator Variables

There are two moderator variables:

(a) Gender at two levels:

(i) Male(ii)Female

(b) **Extraversion Personality domain at two levels:**

(i) Low Extraversion (intraverts)

(ii) High Extraversion (extraverts)

c. **Dependent Variables**

These are students learning outcomes.

i. Students' Achievement in Basic Science

ii. Students' Attitude to Basic Science

Table 3.1. Factorial Matrix of The Study: 3×2×2

Treatment	**Gender**	**Extraversion Personality trait**	
		Low Extraversion(introverts)	**High Extraversion (extroverts)**
Freewriting Brainstorming strategy	Male		
	Female		
Questioning Brainstorming strategy	Male		
	Female		
Conventional Lecture strategy	Male		
	Female		

3.3.0 Selection of Participants

A total of 450 participants for the study were drawn from nine Junior Secondary Schools in Osun Statewith an average of 50 participants per school. Three Junior Secondary Schools were purposively selected from each of the three senatorial districts in Osun State namely, Osun West (Ikire/Ejigbo), Osun East (Ife/Ijesha) and Osun Central (Ikirun/Ila). The selected schools were government-owned schools, co-educational and had an average population of fifty students in JSS 11 class. As at the time of this study, the JSS 1 students were just resuming to school in the state and were not settled, hence, the choice of JSS II students. Besides, the students have had the experience of learning basic science in JSS I and were also not under examination stress as JSS III.

The following criteria were used in the selection of schools:

(a) the school must be a public co-educational public school;

(b) The JSS 11 students in the school had not been taught the topics trated in the package used as treatment;

(c) The school had the topics used as treatment in the scheme for the period;

(d) The school had presented candidates for the Junior Secondary School examination in the school for the past five years;

(e) The school had graduate Basic science teacher teaching JSS II students; and

(f) The school authority showed the willingness to participate in the programme.

The schools were randomly assigned to treatment and the control group in each senatorial district. Three schools were exposed to Brainstorming Freewriting teaching, three schools to Brainstorming Questioning strategy and three to the Conventional Lecture method. Intact classes were used.

3.4.0 Selection of Topics

Topics and concepts selected for teaching in this study were derived from the themes in the Basic Science Curriculum as packaged by Nigerian Educational Research and Development Council (NERDC). The themes in the scheme of the selected schools during the period of treatment are: Energy, Ecology and Sexually transmitted infections (STIs) and HIV/AIDS.

3.5.0 Research Instruments

Research instruments developed for the study were:

Students' Basic Science Achievement Test (BSAT)

Attitude of Students to Basic Science Scale (ASBSS)

Students' Extraversion Personality Traits Scale (SPTS)

Teachers' Instructional Guide for Freewriting Brainstorming Instructional Strategy (FBIS).

Teachers' Instructional Guide for Questioning Brainstorming Instructional Strategy (QBIS)

Teachers' Instructional Guide for Conventional Lecture Strategy (IGMCS)

Evaluation Sheet for Assessing Teachers' Performance During Training (ESATP).

3.5.1 Students' Basic Science Achievement Test (SBSAT)

This instrument was constructed by the researcher to measure students' level of understanding in the selected concepts before and after treatment. The SBSAT had two sections- the first section contains demographic variables of the students such as name, school, local government area, age, sex and class while the second section consists of thirty multiple choice items on the selected topics of Basic Science. The content covered was Energy, Ecology and Prevention of STDs and HIV/AIDS. The SBSAT consisted of ten questions per topic. Alternatives for the questions range from A to D. The total mark obtainable from SBSAT is 30.

Test items were generated to cover the Bloom's cognitive domain of knowledge and comprehension (lower cognitive domain) and higher thinking skills (higher cognitive domain), in accordance with the assertion of Tan (2002) that thinking can be stimulated by asking questions, which gradually increase in complexity and not difficulty.

Table 3.2. Table of Specification for SBSAT

Topic	Knowledge	Comprehension	Thinking	Total
Energy	3	3	4	10
Ecology	3	3	4	10
STI'S and HIV/ AIDS	3	3	4	10

The instrument, (SBSAT) was adjudged adequate in scope and content through peer and expert reviews. Experts consulted include curriculum specialists at Teacher Education Department, University of Ibadan and the researcher's supervisor. It was then administered to 50 JSS students in two Secondary Schools in Ile-Ife who had similar characteristics with the subjects of the main study in non participating schools. The test was administered twice with a time-lag of two weeks. The test-retest yielded a reliability coefficient of 0.78.

3.5.2 Students' Attitude to Basic Science Scale (SABSS)

The instrument was developed by the researcher to identify Junior Secondary School students' attitude towards the learning of Basic Science in general, and towards the methodology of teaching it in particular. It consisted of two parts - Section A and Section B. Section A sought for background information of the respondents' name, sex, school, class and age. Section B consisted of 30 items that were relevant to assess the disposition of the students to learning of Basic Science. The statements were on a four-point Likert type ordinal scale of Strongly Agree (SA), Agree (A), Disagree (D), and Strongly Disagree (SD). Scoring

of the items ranges from 4, 3, 2, to1 for SA, A, D, and SD respectively, while negatively worded items were scored in the reverse order. Total score of a student for all the items was taken as the index of attitude.

Validation of SABSS

The instrument was given to the course supervisor and then to two secondary school Basic Science teachers for face and content validity**.**

3.5.3. Students' Extraversion Personality Traits Scale (SPTS)

Students' Extraversionpersonality trait scale was included in this study to find out the relative numbers of Extraverts and Introverts in the class. The instrument consisted of two sections, section A contains the demographic variables of students such as name, school, age sex and class. Section B consists of 10 self-descriptive sentences on the domain of extraversion adapted from 'A very brief measure of the Big-Five personality domains' (Gosling, Rentfrow and Swann (2003). There were five positive and five negative self-descriptive sentences based on self-report measures (Goldberg, 1992).

The questionnaire expected each respondent to do a self- reflection and respond to each item based on closed response model of a 2-point scale of Agree (A) and Disagree (D). A positive item attracts 2 points for Agree and 1point for Disagree. The score was reversed for the negative items. The total score on the extraversion domain for each respondent was presented as percentage score. Scores above 50% tend towards extroversion (High) while below 50% (Low) tend towards introversion. Extroversion and introversion is typically viewed as a single continuum (Thompson, 2008). Hence, to be high in one is to be low in the other one.

This instrument was subjected to face and content validation with the help of an experienced University lecturer in Psychology, Guidance and Counseling and English

Language respectively. The internal consistency was determined using Cronbach method which yielded a reliability index of 0.84.

3.5.4. Teachers'Instructional Guide for Freewriting Brainstorming Instructional Strategy (FBIS)

The Instructional Guide was adapted from Roland (2009) the researcher and used as a guide by teachers to teach students in the activities involved in generation of ideas (brainstorming) using freewriting strategy for first experimental group. The guide consists of general information, procedure to follow, objective and content of the subject matter, instructional aids and instructional materials to be used by students.

Validation of FBIS

The guide was given to experienced science teachers in three secondary schools and two university lecturers to examine its face and content validity. Their recommendations were incorporated into the guide. Pilot test was conducted to a group of students who were not part of the target population.

3.5.5. Teachers' Instructional Guide for Questioning Brainstorming Instructional Strategy (QBIS)

The instructional guide was adapted from " Questioning strategies in the classroom"(Ebert, Ebert and Bentley, 2011) by the researcher and used as a guide by teachers to teach students in the activities involved in brainstorming using Questioning strategy for the second experimental group. The guide consists of general information, procedure to follow, objective and content of the subject matter. Activity question cards containing lead questions on each of the selected concepts were also included.

Validation of QBIS

The guide was given to three experienced science teachers and university lecturer in Teacher Education Department to examine its content and face validity. Necessary corrections were then made on the package.

3.5.6 Teachers'Instructional Guide on ConventionalLecture Method (IGMCS)

The instructional guide consists of lesson notes to teach conventionally. Charts, posters and other required study materials to teach the concept were provided. The procedure to follow was also included.

3.5.7 Evaluation Sheet for Assessing Teachers' Performance during Training

The instrument was designed by the researcher to assess the participating teachers' performance based on the procedures for implementing brainstorming strategy. The instrument consisted of the various ways of rating teachers while teaching in the classroom, which included lesson preparation, introduction, communication, teacher-learner relationship, class control, instructional materials and subject mastery (Appendix VII).

Teachers were scored on 5-point scale of Very Good, Good, Average, Poor and Very Poor and the grading ranged from 5 to 1, where the score for Very Good is 5 and Very Poor is 1. The maximum score was 150. A participant was expected to score a minimum of 70 to be considered suitable to participate.

The instrument was validated for face and content validity by four Inspectors of Education at the State Ministry of Education.

3.6.0. Procedure for the Study

Table 3.3Procedure for the Study on Basic Science Curriculum

Week	Activities
1st	Selection of schools. Permission sought from school authorities of selected schools. Familiarization with the Basic Science teachers of the schools.
2nd	Training of research assistants as observers for participating teachers by the researcher.
3rd-4th	Administration of SBSAT, ASBSS and SPTS as pre-treatment to all subjects by the researcher and graduate assistants.
5th	Training of participating teachers and the re-training of graduate assistants for treatment 1 and 2. Presentation of topics to be taught in Basic Science to the teachers by the researcher.
6th- 13th	Application of treatment in Experimental Groups 1 and 2. Collection of weekly data on performance of students at lessons. This takes eight weeks.
14th-16th	Post-treatment administration of instruments SBSAT and ASBSS to all subjects by the researcher and research assistants.
17th-18th	Collection and Collation of data.

3.6.1 Training of Facilitators

The training involved the following phases:

Phase 1: The general set-up of the study was explained to the participating teachers. The traditional method of brainstorming was explained and practiced by all the teachers.

Phase 11: Four teachers were assigned to each of the instructional strategies, that is four teachers to each of:

1. Experimental Group 1- Brainstorming Freewriting Strategy
2. Experimental Group 11- Brainstorming Questioning Strategy
3. The control group - Conventional Method

Phase III: The researcher gave out the teachers' guide to the respective groups and explained the major differences between experimental I and II. Teachers practiced in turn with one acting as facilitator and the others as students, and the topics used for the practice were those to be used in actual teaching.

At the end of the training, three teachers were dropped and nine teachers were selected to take part in the study. The conventional method was also taught on how to modify the method.

3.6.2 Administration of Pretest

The administration of pretest took two weeks, which involved presentation of the prepared instruments to the JSS One students in the sampled schools for their interaction. The instruments used were:

i. Students' Basic Science Achievement Test (SBSAT)
ii. Attitude of Students to Basic Science Scale (ASTBS)
iii. Students' Extraversion Personality Scale (SPS)

The purpose of the pretest is to assess students' level of understanding in Basic Science, as well as their disposition to Basic Science before treatment.

3.6.3 Administration of Treatment

The study involved two treatment and one control groups and so there were three groups in JSS One. Each of the groups consisted of male and female students of varying

extraversion (High and Low) level of personality trait. Each group was exposed to one of the instructional strategies outlined on Table 3.4

The Procedure for the conduct of the Three Strategies

The period of treatment lasted six weeks.

I. Procedure for the conduct of Freewriting Brainstorming Instructional Strategy

Step I: The teacher writes the topic of the day on the board in form of a challenge egHow is water maintained on earth?

Step II: Teacher introduces an energizer.

StepIII: Teacher introduces the lesson, provide some diagrams, a sentence, drama sketch as mind prompts and explains ground rules for the lesson such as no criticism,

Step IV: Teacher gives instruction for brainstorming session such as: i. students to observe and reflect on the mind prompt provided, ii: write down whatever comes into their minds on the subject for a specified period of time, usually 5minutes in words or diagrams individually.

Step V: Content of the lesson is gradually developed from the ideas written by students. Some students may be called upon by teachers to read out what they have written or the teacher may collect the ideas and read out the relevant ideas to make it anonymous.

Step VI: Ideas are categorized through collaborative efforts of teacher and students. Teacher supplies missing links, consolidate issues and writes major points on the board.

Step VII: The whole list of ideas is reviewed to ensure that everybody understands the concept.Students write the notes in their notebooks.

Step VIII: Teacher appreciates the class for their contribution.

Step IX: The written ideas of students are evaluated after the lesson.

Step X: The notes copied by students are also collected for checking by the teacher

II. **Procedure for the conduct of Questioning Brainstorming Instructional Strategy**

Step I: The teacher writes the topic of the day on the board in form of a challenge e.gHow is water maintained on earth?

Step II: Teacher introduces an energizer.

Step III: Teacher introduces the lesson, provide some questions as mind prompts and explains ground rules for the lesson such as no criticism,

Step IV: Teacher gives instruction for brainstorming session such as: i. students to observe and reflect on thequestions provided, ii: write down answers to the questions as it comes into their minds on the subject for a specified period of time, usually 5minutes in words or diagrams individually.

Step V: Content of the lesson is gradually developed from the ideas written by students. Some students may be called upon by teachers to read out what they have written or the teacher may collect the ideas and read out the relevant ideas to make it anonymous.

Step VI: Ideas are categorized through collaborative efforts of teacher and students. Teacher supplies missing links, consolidate issues and writes major points on the board.

Step VII: The whole list of ideas is reviewed to ensure that everybody understands the concept. Students write the notes in their notebooks.

Step VIII: Teacher appreciates the class for their contribution.

Step IX: The written ideas of students are evaluated after the lesson.

Step X: Students' notebooks are also collected by teacher to ensure the notes are put down correctly.

III. **Procedure for the conduct of Lecture method.**

Step I: Teacher writes the topic on the board e.g. Water Cycle

Step II: Teacher pastes or hangs a well-labelled chart of the concept e.g Water Cycle

Step III: With the aid of the diagram, teacher explains the concept and the related terms.

Step IV: Teacher writes notes for students to copy.

Step V: Students copy down the notes into their notebooks and draw necessary diagrams.

Step VI: The teacher asks the class whether they have any question.

Step VII: Teacher later collects students' notebooks and check to ensure the note is correctly written.

3.6.4 Administration of Posttest

The same instruments used for pretest were administered to the same students after treatment, and a period of two weeks was used.

3.7.0 Methods of Data Analysis

The data collected from this study were analysed with the use of descriptive and inferential statistics. Descriptive statistics such as means, percentages and standard deviation were used whilethe inferential statistics used involved computing Analysis of Covariance (ANCOVA) to test all stated Null hypotheses.In order to detect the magnitude of the groups' performance, Multiple Classification Analysis (MCA) was employed. Test of Significance was at p-value of 0.05

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.0 This chapter presents results obtained from analysis of the collected data. Presentation was also based on the seven Null hypotheses formulated for the study.

4.1 Demographic Data of Participants

The demography of the respondents are presented below:

1. **Distribution of Participants by Gender**

Fig. 1: Bar Chart showing the distribution of the respondents by Sex

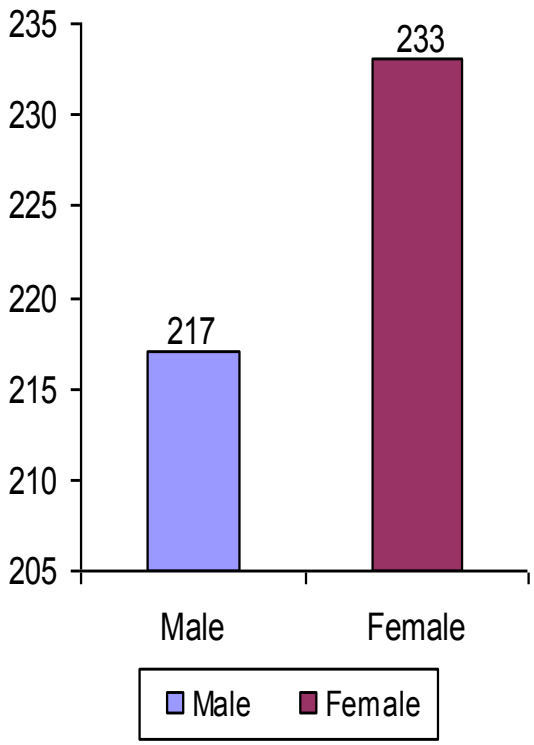


Fig 4.1: Bar chart showing distribution of participants by Gender

Fig. 4.1 shows that there were more female (51.8%) than males (48.2%).

Distribution of Respondents by Age

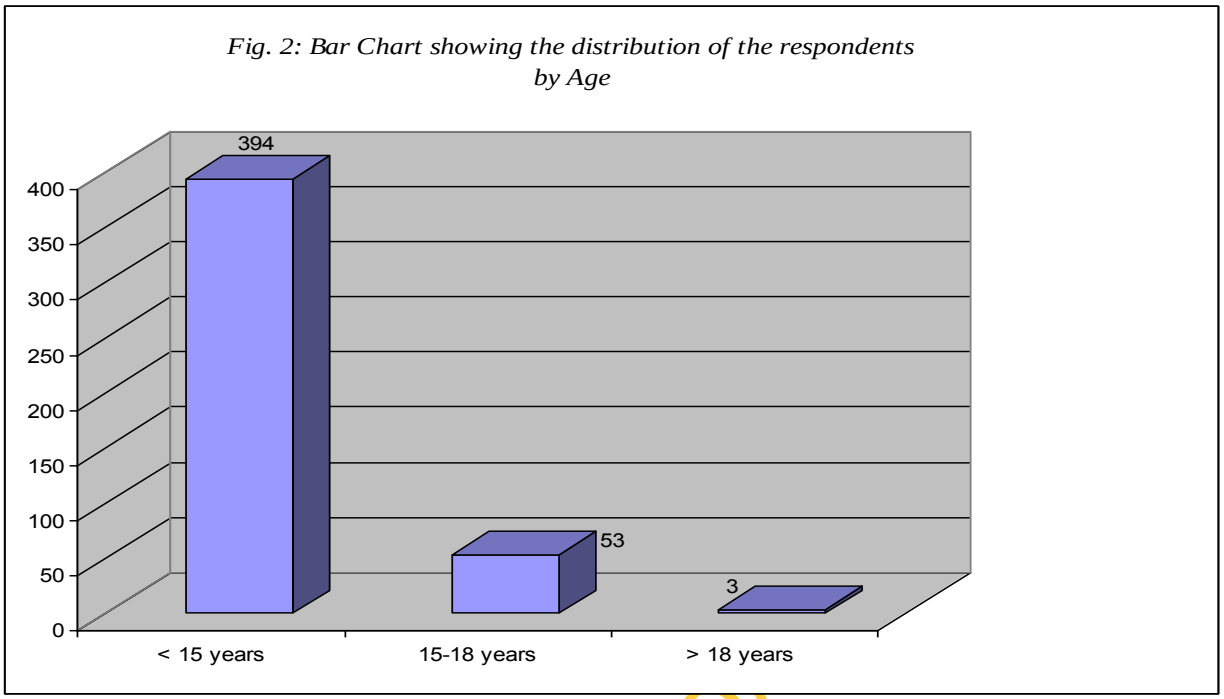


Fig 4.2.Bar Chart showing Distribution of Participants by Age.

The bar chart (Fig 4.2) shows that the age of 82% of the respondents is below 15 years. This connotes that students in the lower post-primary education are predominantly young people.

4.2 Descriptive Presentation of Students' Achievement Scores Based on Treatments, Extraversion Personality Traits and Gender.

Descriptive statistics of achievement scores of students based on the application of the two brainstorming strategies, personality traits and gender are presented below:

Table 4.1: Descriptive Statistics of Achievement Scores of Treatment groups, Personality Traits and Gender on Students' Achievement in Basic Science.

Table	Personality Trait	Gender	Mean	Std. Deviation	N
Treatment I	Low	Male	24.8966	3.2879	29
		Female	23.6786	3.6215	28
	High	Male	25.0000	2.7749	41
		Female	24.4423	2.8725	52
	Total	Male	24.9571	2.9754	70
		Female	24.1750	3.1534	80
Treatment II	Low	Male	15.9310	3.9725	29
		Female	16.3571	3.7831	28
	High	Male	16.8049	3.6001	41
		Female	16.0962	3.1639	52
	Total	Male	16.4429	3.7557	70
		Female	16.1875	3.9195	80
Control	Low	Male	13.8333	3.2765	18
		Female	14.1429	3.9195	14
	High	Male	12.4407	2.9785	59
		Female	12.6610	2.8199	59
	Total	Male	12.7662	3.0860	77
		Female	12.9452	3.0862	73
Total	Low	Male	18.8553	5.9860	76
		Female	18.8429	5.4868	70
	High	Male	17.3617	6.0796	141
		Female	17.5153	5.7643	163
	Total	Male	17.8848	6.0752	217
		Female	17.9142	5.7033	233

Table 4.1 shows the various mean and standard deviation of scores of treatment groups and other variables involved in the analysis. The table also shows the sample size for each group which is the same (150). It also shows that Treatment 1 has the highest mean score (24.5400) followed by Treatment II (16.3067) and lastly followed by the Control group (12.8533). The table also presents the Grand mean for the descriptive analysis of effects of the variables on students' achievement in Basic Science as 17.90.

4.3 Bar Chart Presentation of Pretest and Posttest Mean Achievement Scores of the Treatment groups.

Figures 4.3: Bar Chart Representation of The Pre test Mean Achievement Scores and The Post test Mean Achievement Scores of the Treatment Groups.

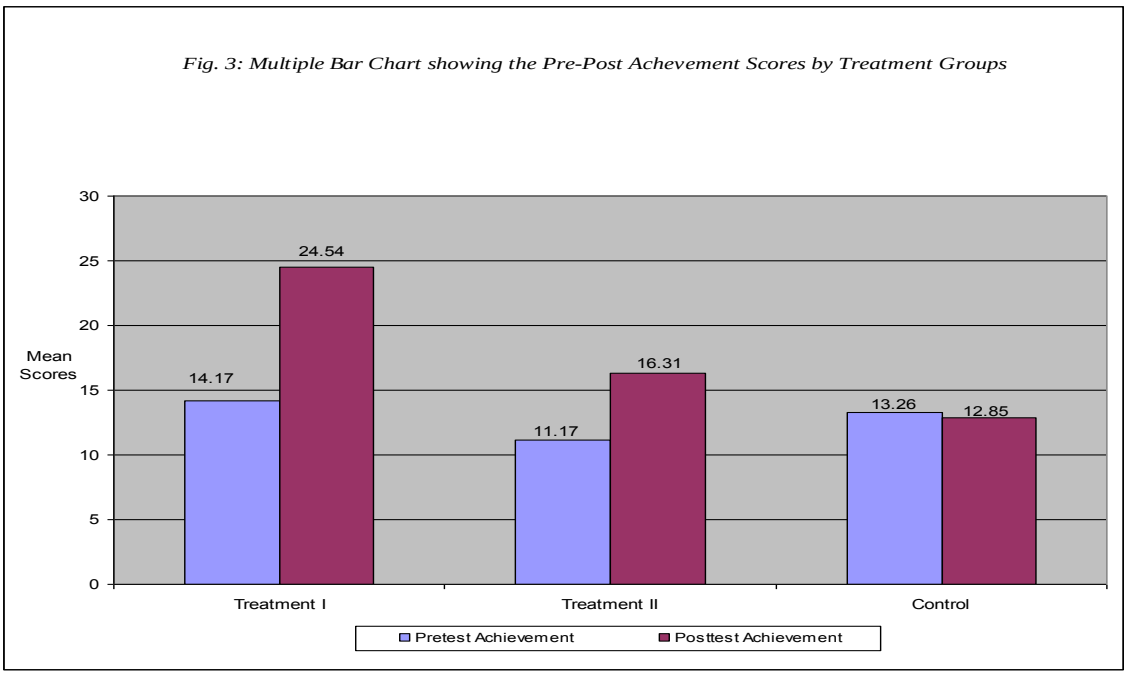


Figure 4.3 indicates that in the Treatment group I, the post test achievement mean score is higher (24.54) than the score in the pre-test (14.17). It also shows that in Treatment II, post-test also recorded higher score (16.31) than the pre-test (11.17).

Figure 4.4: Bar Chart Representation of Pre test Achievement Mean Score and Post test Achievement Mean Score of two Extraversion Personality Trait Groups.

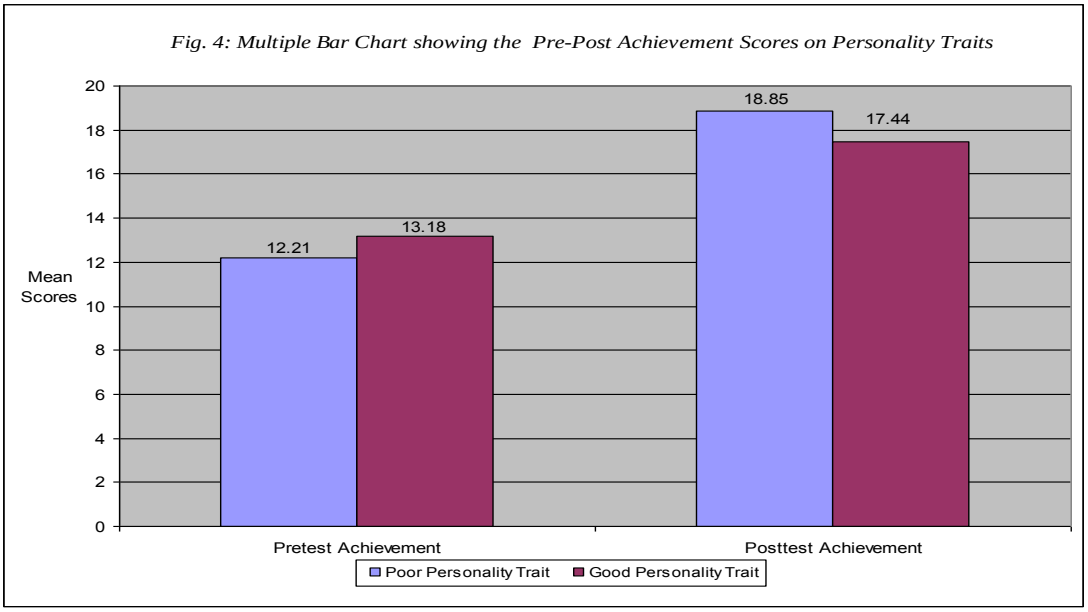
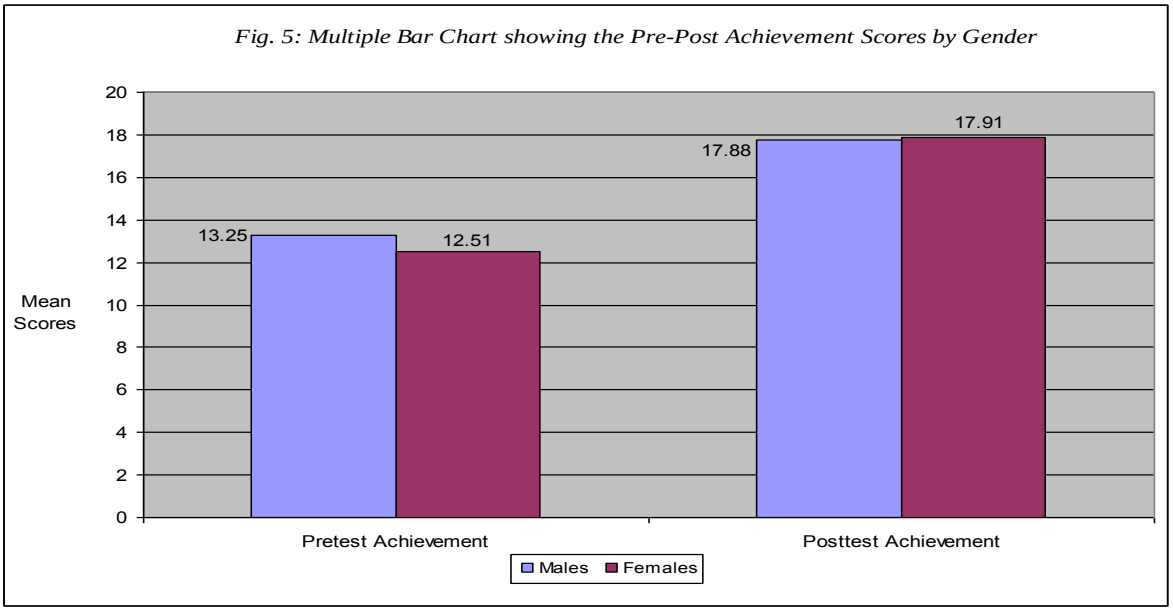


Figure (4.4) indicates that the students with High Personality Traits (Extroverts) had higher achievement score (13.18) in the pre-test than the Low Personality Trait students – Introverts (12.21) while in post test the Introverts had higher achievement mean score (18.85) than the Extroverts (17.44)

Figures 4.5: Bar Chart Representation of The Pre test Achievement Mean Score and The Post test Achievement Mean Score based on Gender.



higher (24.54) than the score in the pre-test (14.17). It also shows that in Treatment II, post-test also recorded higher score (16.31) than the pre-test (11.17).

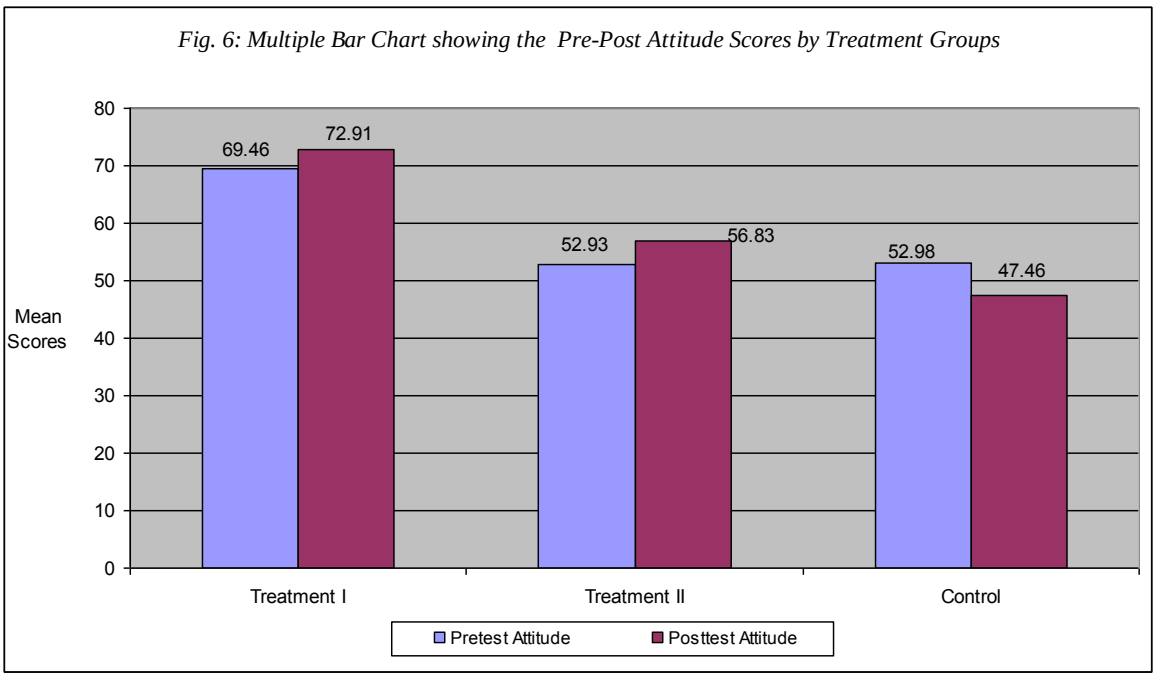
4.3 Descriptive Presentation of Students' Attitude Mean Scores based on Treatment, Personality Traits and Gender.

Table 4.2: Descriptive Statistics Showing Post Test Students' Attitude Scores towards Basic Science based on Treatment, Personality Trait and Gender.

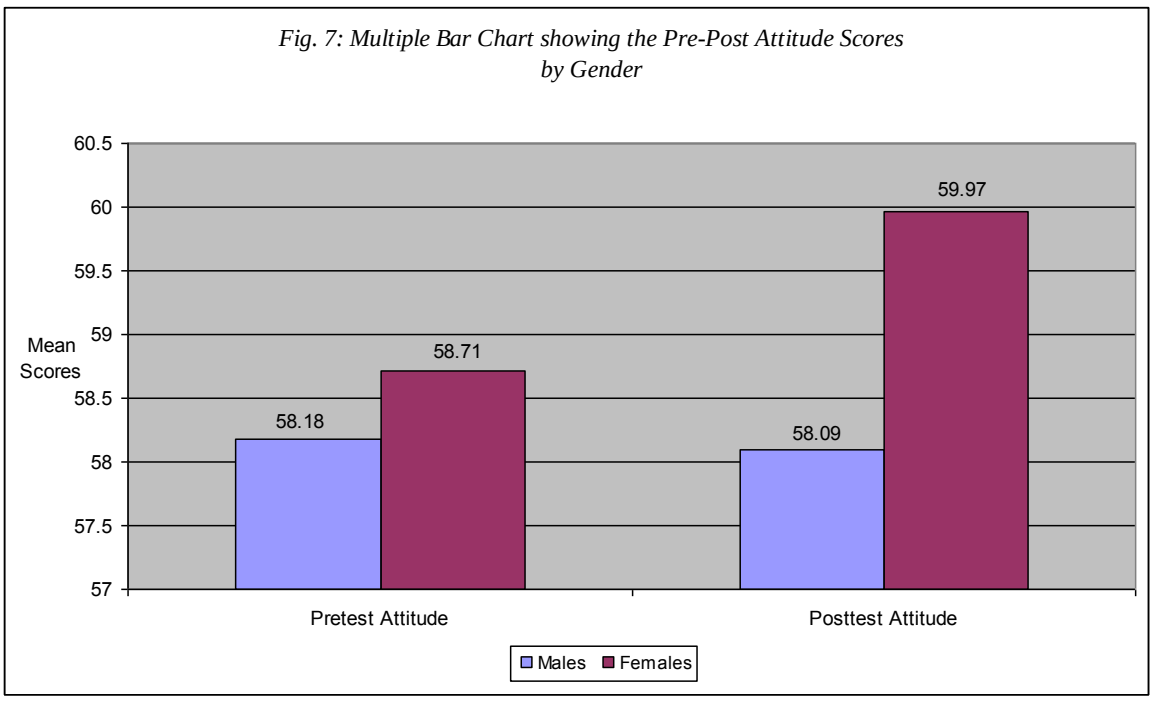
Treatment Group	Gender	School	Mean	Std. Deviation	N
Treatment I	Low	Male	70.8276	4.9286	29
		Female	71.0000	5.0626	28
	High	Male	73.490	4.0128	41
		Female	74.6731	3.9888	52
	Total	Male	72.3571	4.5684	70
		Female	73.3841	4.7052	80
Treatment II	Low	Male	50.1724	9.0122	29
		Female	52.2500	5.8603	28
	High	Male	59.3171	5.5201	41
		Female	61.0385	4.9068	52
	Total	Male	55.5286	8.4386	70
		Female	57.9625	6.7138	80
Control	Low	Male	51.3333	7.1208	18
		Female	47.5000	4.0525	14
	High	Male	46.2712	6.9798	59
		Female	47.4576	6.8439	59
	Total	Male	47.4545	7.2919	77
		Female	47.4658	6.3794	73
Total	Low	Male	58.3289	12.1966	76
	High	Male	57.9645	12.7192	141
		Female	60.4724	12.4852	163
	Total	Male	58.0922	12.5115	217
		Female	59.9700	12.1731	233

Table 4.2 shows Students' Attitude Mean and Standard Deviation scores of Treatment groups, Personality Traits and Gender towards Basic Science.

Figures 4.6.: Bar Chart Representation of Pre test and Posttest Mean Scores of Students' Attitude towards Basic Science for the Treatment and Control Groups.



Figures 4.7: Bar Chart Representation of Pre test and Post test Mean Score of Students' Attitude towards Basic Science according to Gender.



4.4. Testing of Hypotheses

4.4.1. Effect of Treatment on Students' Achievement in Basic Science.

Hypothesis 1a: There is no significant main effect of Treatment on students' achievement in Basic Science

Results from table 4.3 shows that there was significant effect of the brainstorming strategies on Students' Achievement ($F_{(2, 449)} = 364.14$; $p < .05$); hence, the null hypothesis is rejected.

Table 4.3: ANCOVA Table Showing Effects of Treatment on Students' Achievement in Basic Science.

Source	Sum of Squares	DF	Mean Square	F	Sig.	Eta^2/ Effect
Corrected Model	11183.633	12	931.969	93.952	.000	.721
Pretest	265.982	1	265.982	26.814	.000	.058
Main Effect: Treatment	7224.248	2	3612.124	364.140	.000	.625
Error	334.867	437	7.347	.741	.477	.003
Total	15518.500	449	9.920			

Table 4.3 shows that Treatment had significant main effect on students' achievement in Basic Science ($F_{(2, 449)} = 364.14$; $p < .05$) with an effect size (η^2) of .625.

4.4.2. Effect of Treatment on Students' Attitude to Basic Science

Hypothesis 1b: There will be no significant main effect of Treatment on Students' Attitude to Basic Science

Results from table 4.4 shows that there was a significant main effect of Treatment on Students' Attitude to Basic Science ($F_{(3,446)}$=259.38; P<.05) hence, the Null Hypothesis is rejected.

Table 4.4: ANCOVA table Showing Effects of Treatment on Students Attitude to Basic Science.

Source	Sum of Squares	DF	Mean Square	F	Sig.	*Eta*^{2}/ Effect
Corrected Model	5765.362	12	4480.447	132.100	.000	.784
Pretest	271.902	1	271.902	8.017	.005	.018
Main Effect: Treatment	17594.914	2	8797.457	259.381	.000	.543
Error	14821.770	437	33.917			
Total	68587.131	449				

Table 4.4. shows that the Brainstorming strategies (treatment) had significant effect on students' attitude towards Basic Science ($F_{(2, 449)} = 259.38$; $p < .05$), with effect size of .543.

4.4.3 Effect of Personality Traits on Students' Achievement in Basic Science

Hypothesis 2a: There is no significant main effect of Personality Traits on Students' Achievement in Basic Science

Results from Table 4.5. shows that there was a significant effect of Personality Traits on Students' Achievement. ($F_{(1, 449)} = 2.07$; $p > .05$). Hence, the Null hypothesis is rejected.

Table 4.5: ANCOVA table Showing Effects of Personality Traits on Students Achievement in Basic Science.

Source	Sum of	DF	Mean	F	Sig.	Eta^2/
Corrected Model	11183.633	12	931.969	93.952	.000	.721
Pretest	265.982	1	265.982	26.814	.000	.058
Main Effect: Personality Trait	20.547	1	20.547	2.071	.151	.005
Error	4334.867	437	9.920			
Total	15518.500	449				

Table 4.5. shows that Personality Traits had significant main effect on Students' Achievement. ($F_{(1, 449)} = 2.07$; $p > .05$).

4.4.4 Effect of Extraversion Personality Trait on Students' Attitude to Basic Science

Hypothesis 2b: There is no significant main effect of Extraversion Personality Traits on Students' Attitude to Basic Science.

Results from Table 4.4 shows that there was a significant effect of Personality traits on students' attitude towards Basic Science ($F_{(1, 449)} = 29.24$; $p < .05$), Hence, the Null hypothesis is rejected.

Table 4.6: ANCOVA table Showing Effects of Personality Traits on Students' Attitude to Basic Science.

Source	Sum of Squares	DF	Mean Square	F	Sig.	Eta^2/ Effect
Corrected Model	5765.362	12	4480.447	132.100	.000	.784
Pretest	271.902	1	271.902	8.017	.005	.018
Main Effect: Personality Trait	991.554	1	991.554	29.235	.000	.063
Error	14821.770	437	33.917			
Total	68587.131	449				

Table 4.6 shows that Personality traits had significant main effect on Students' Attitude to Basic Science ($F_{(1, 449)} = 29.24$; $p < .05$) with effect size .063.

4.4.5 Effect of Gender on Students' Achievement in Basic Science

Hypothesis 3a: There is no significant main effect of Gender on students' Achievement in Basic Science

Results from Table 4.5 shows that there was no significant effect of Gender on students' achievements ($F_{(1, 449)} = 0.12$; $p > .05$).; hence, the Null hypothesis is not rejected.

Table 4.7: ANCOVA table Showing Effects of Gender on Students' Achievement in Basic Science.

Source	Sum of Squares	DF	Mean Square	F	Sig.	Eta^2/ Effect
Corrected Model	11183.633	12	931.969	93.952	.000	.721
Pretest	265.982	1	265.982	26.814	.000	.058
Main Effect: Gender	1.209	1	1.209	.122	.727	.000
Error	4334.867	437	9.920			
Total	15518.500	449				

Table 4.7 shows that there was no significant effect of Gender on students' achievements ($F_{(1, 449)} = 0.12; p > .05$).

4.4.6 Effect of Gender on Students' Attitude to Basic Science

Hypothesis 3b: There is no significant main effect of Gender on Students' Attitude to Basic Science

Results from Table 4.8 shows that there was no significant effect of gender on students' attitude ($F_{(1, 449)} = 0.50; p > .05$),; hence, the Null hypothesis is not rejected.

Table 4.8: ANCOVA table Showing Effects of Gender on Students Attitude to Basic Science

Source	Sum of Squares	DF	Mean Square	F	Sig.	Etd^2/ Effect
Corrected Model	5765.362	12	4480.447	132.100	.000	.784
Pretest	271.902	1	271.902	8.017	.005	.018
Main Effect: Gender	7.030	1	17.030	.502	.479	.001
Error	14821.770	437	33.917			
Total	68587.131	449				

Table 4.8 shows that there was no significant effect of gender on students' attitude ($F_{(1, 449)} = 0.50; p > .05$).

4.4.7 Interaction Effect of Treatment and Personality Traits on Students' Achievement in Basic Science

Hypothesis 4a: There is no significant interaction effects of the Brainstorming strategies and Personality traits on students' Achievement in Basic Science

Results from table 4.9 below shows that there was a significant interaction effect of the brainstorming techniques and Personality Traits on students' achievements ($F_{(2, 449)} = 4.03; p < .05$); hence, the Null hypothesis is rejected.

Table 4.9: ANCOVA table Showing Interaction Effects of Treatment and Personality Traits on Students' Achievement in Basic Science.

Source	Sum of Squares	DF	Mean Square	F	Sig.	Eta^2/ Effect
Corrected Model	11183.633	12	931.969	93.952	.000	.721
Pretest	265.982	1	265.982	26.814	.000	.058
2-way Interactions: Treatment x P.T.	79.879	2	39.939	4.026	.019	.018
Error	4334.867	437	9.920			
Total	15518.500	449				

Table 4.9. shows there was a significant interaction effect of the Brainstorming techniques (Treatment) and Personality Traits on students' achievements ($F_{(2, 449)} = 4.03$; $p < .05$) with effect size .018

4.4.8 . Interaction Effect of Brainstorming Strategies and Personality Traits on Students' Attitude to Basic Science

Hypothesis 4b: There is no significant interaction effects of the Brainstorming strategies and Personality traits on students' Attitude to Basic Science.

Results from Table 4.10 shows that there was a significant interaction effect of the Brainstorming strategies and Personality Traits on Students' Achievements ($F_{(2, 449)} = 30.28$; $p < .05$); hence, the Null hypothesis is rejected.

Table 4.10: ANCOVA table Showing Interaction Effects of Treatment and Personality Traits on Students Attitude in Basic Science

Source	Sum of Squares	DF	Mean Square	F	Sig.	*Eta*^{2}/ Effect
Corrected Model	5765.362	12	4480.447	132.100	.000	.784
Pretest	271.902	1	271.902	8.017	.005	.018
2-way Interactions: Treatment x P.T.	2054.108	2	1027.054	30.281	.000	.122
Error	14821.770	437	33.917			
Total	68587.131	449				

Table 4.10 above shows that there was a significant interaction effect of the Brainstorming strategies and Personality Traits on Students' Achievements ($F_{(2, 449)} = 30.28$; $p < .05$) with effect size .112

4.4.9 Interaction Effect of Treatment and Gender on Students' Achievement in Basic Science

Hypothesis 5a: There is no significant interaction effects of Treatment and Gender on Students' Achievement in Basic Science

Results from table 4.11 below shows that there was no significant interaction effect of the brainstorming techniques and Gender on students' achievements ($F_{(2, 449)} = 0.68$; $p > .05$); hence, the Null hypothesis is not rejected.

Table 4.11: ANCOVA table Showing Interaction Effects of Treatment and Gender on Students Achievement in Basic Science.

Source	Sum of Squares	DF	Mean Square	F	Sig.	Eta^2/ Effect Size
Corrected Model	11183.633	12	931.969	93.952	.000	.721
Pretest	265.982	1	265.982	26.814	.000	.058
2-way Interactions: Treatment x Gender	13.406	2	6.703	.676	.509	.003
Error	4334.867	437	9.920			
Total	15518.500	449				

Table 4.11 shows that the brainstorming strategies (Treatment) and gender had no significant interaction effect on students' achievement in Basic Science ($F_{(2,449)} = 0.68$; $p > .05$).

4.4.10 Interaction Effect of Treatment and Gender on Students' Attitude to Basic Science

Hypothesis 5b: There is no significant interaction effects of the Brainstorming strategies and Gender on Students' Attitude to Basic Science

The result from table 4.12 below shows that there was no significant interaction effect of the brainstorming strategies and Gender on students' attitude Science ($F_{(2,449)} = 2.20$; $p > .05$); hence, the Null hypothesis is accepted.

Table 4.12: ANCOVA table Showing Interaction Effects of Treatment and Gender on Students Attitude in Basic Science.

Source	Sum of Squares	DF	Mean Square	F	Sig.	*Eta*^{2} Effect
Corrected Model	5765.362	12	4480.447	132.100	.000	.784
Pretest	271.902	1	271.902	8.017	.005	.018
2-wayInteractions:Treatment x Gender	148.994	2	74.49	2.196	.112	.010
Error						
Total	14821.770	437	33.917			
	68587.131	449				

Table 4.12 shows that there was no significant interaction effect of the Brainstorming strategies (Treatment) and Gender on students' attitude to Basic Science ($F_{(2,449)} = 2.20$; $p > .05$).

4.4.11 Interaction Effect of the Personality Traits and Gender on Students' Achievement in Basic Science

Hypothesis 6a: There is no significant interaction effects of Personality traits and Gender on Students' Achievement in Basic Science

Results from table 4.13 below shows that there was no significant interaction effect of Personality Traits and Gender on students' achievements ($F_{(1,449)} = 0.10$; $p > .05$); hence, the Null hypothesis is not rejected.

Table 4.13: ANCOVA Showing Interaction Effects of Personality Traits and Gender on Students' Achievement in Basic Science.

Source	Sum of Squares	DF	Mean Square	F	Sig.	Eta^2/ Effect
Corrected Model	11183.633	12	931.969	93.952	.000	.721
Pretest	265.982	1	265.982	26.814	.000	.058
2-way Interactions: P.T x Gender	.102	1	.102	.010	.919	.000
Error	4334.867	437	9.920			
Total	15518.500	449				

Table 4.13 above shows that there was no significant interaction effect of Personality Traits and Gender on students' achievements ($F_{(1, 449)} = 0.10$; $p > .05$).

4.4.12. Interaction Effect of the Personality Traits and d Gender on Students' Attitude to Basic Science

Hypothesis 6b: There is no significant interaction effects of Personality traits and Gender on Students' Attitude to Basic Science

Results from table 4.14 below shows that there was no significant interaction effect of Personality Traits and Gender on students' attitude towards Basic Science ($F_{(1, 449)} = 2.26$; $p > .05$),; hence, the Null hypothesis is not rejected.

Table 4.14: ANCOVA Showing Interaction Effects of Personality Traits and Gender on Students Attitude in Basic Science

Source	Sum of Squares	DF	Mean Square	F	Sig.	*Eta*^{2}/ Effect
Corrected Model	5765.362	12	4480.447	132.100	.000	.784
Pretest	271.902	1	271.902	8.017	.005	.018
2-way Interactions:						
P.T x Gender	76.764	1	76.764	2.263	.133	.005
Error						
Total	14821.770	437	33.917			
	68587.131	449				

Table 4.14: shows that there was no significant interaction effect of Personality Traits and Gender on students' attitude towards Basic Science ($F_{(1,449)} = 2.26; p > .05$)

4.4.13 Interaction Effect of Treatment, Personality Traits and Gender on Students' Achievement in Basic Science

Hypothesis 7a: There is no significant interaction effects of treatment, Personality Traits and Gender on students' Achievement in Basic Science

Results from table 4.15 shows that there was no significant interaction effect of treatment, Personality Traits and Gender on students' achievement($F_{(2, 449)} = .74; p > .05$); hence, the Null hypothesis is accepted.

Table 4.15: ANCOVA Showing Interaction Effects of treatment, Personality Traits and Gender on Students Achievement in Basic Science.

Source	Sum of Squares	DF	Mean Square	F	Sig.	Eta^2/ Effect
Corrected Model	11183.633	12	931.969	93.952	.000	.721
Pretest	265.982	1	265.982	26.814	.000	.058
3-way Interactions: Treatment x P.T. x Gender	14.695	2	7.347	.741	.477	.003
Error	4334.867	437	9.920			
Total	15518.500	449				

Table 4.13 above shows that there was no significant interaction effect of Treatment, Personality Traits and Gender on students' achievement ($F_{(2,449)} = .74; p > .05$).

4.4.14 Interaction Effect of Treatment and Personality Traits on Students' Attitude to Basic Science

Hypothesis 7b: There is no significant interaction effects of Treatment, Personality Traits and Gender on Students' Attitude to Basic Science

Results from Table 4.14 shows that there was no significant interaction effect of , Personality Traits and Gender on students' attitude ($F_{(2,449)} = 1.38; p > .05$); hence, the null hypothesis is not rejected.

Table 4.16: ANCOVA Showing Post Test Interaction Effects of Treatment, Personality Traits and Gender on Students Attitude to Basic Science.

Source	Sum of Squares	DF	Mean Square	F	Sig.	$Etα^2$/ Effect
Corrected Model	5765.362	12	4480.447	132.100	.000	.784
Pretest	271.902	1	271.902	8.017	.005	.018
3-way Interactions: Treatment x P.T. x Gender	93.689	2	46.844	1.381	.252	.006
Error	14821.770	437	33.917			
Total	68587.131	449				

Table 4.15 shows that there was no significant interaction effect o Treatmentf, Personality Traits and Gender on students' attitude ($F_{(2, 449)} = 1.38; p > .05$).

4.5.0. Presentation of Multiple Classification Analysis of Students' Achievement and Attitude Based on Treatments, Personality Traits and Gender

Table 4.17: Multiple Classification Analysis (MCA) of Students' Achievement in Basic Science

Variable + Category Grand Mean = 17.90		N	Unadjusted variation	Eta	Adjusted for independent + covariates	Beta
Treatment Group: 2. Treatment II	1. Treatment I	150 150	6.64 -1.59	.83	6.33 -1.22	.81
Personality Traits:	1. Low 2. High	146 304	.95 -.46	.11	.22 -.11	.03
Gender:	1. Male 2. Female	217 233	-.02 .01	.00	.05 -.05	.01
Multiple R-squared Multiple R						.714 .845

Table 4.17 shows the mean scores of the different Treatment Groups.It shows that Treatment Ihad the highest mean achievement score (Grand mean (17.90 + 6.64) = 24.54; while Treatment II ranked next in achievement score (Grand mean (17.90 - 1.59) = 16.31; and the Control group had the lowest mean achievement score (Grand mean (17.90- 5.05) =12.85. These findings imply that the Freewriting Brainstorming Strategy proved to be most effective followed by the Questioning Brainstorming Strategy while the Modified Conventional Lecture method was least effective on students' achievement in Basic Science.

The table also shows the mean scores of the different Personality Traits:

It reveals that students with Low Personality Traits had higher mean achievement scores in Basic Science (Grand mean (17.90 + .95) = 18.85; that students with High Personality Trait (Grand mean (17.90 -.46) = 17.44. This finding shows that the introverts (Low Personality Trait students)

achieved more in Basic Science than the extroverts (High Personality Trait Students).

The table also shows the mean scores of the different Gender:

It shows that the Female gender had higher mean achievement score (Grand mean (17.90 + .01) = 17.91 than the Male counterpart (Grand mean (17.90 -.05) = 17.88.

Table.4.18: Multiple Classification Analysis (MCA) of Students' Attitude towards Basic Science

Variable + Category Grand Mean - 59.06	N	Unadjusted variation	Eta	Adjusted for independent +	Beta
Treatment Group:					
Treatment I	150	13.84		13.11	
Treatment II	150	-2.24		-1.57	
Control	150	-11.60	.85	-11.54	.82
Personality Traits:					
1. Low	146	-.51		-2.59	
2. High	304	.24	.03	1.25	.15
Gender:					
1. Male	217	-.97		-.48	
2. Female	233	.91	.08	.45	.04
Multiple R-squared					.749
Multiple R					.865

Table 4.18 shows the mean attitude scores of the different Treatment Groups, Personality Traits and Gender.

The table shows that Treatment I had the highest mean attitude score (Grand mean (59.06 + 13.84) = 72.91; while Treatment II ranked next in attitude score (Grand mean (59.06 – 2.24)

= 56.83; while the Control group had the lowest mean attitude score (Grand mean (59.60 – 11.06) =47.46. These findings imply that the Freewriting Brainstorming Strategy proved to be most effective followed by the Questioning Technique while the Modified Conventional Lecture method was least effective in improving attitude of students towards Basic Science.

The table also reveals that students with High Personality Trait had higher mean attitude score towards Basic Science (Grand mean (59.06 + .24) = 59.31) than students with Low Personality Trait (Grand mean (59.06 -.51) = 58.55. This finding connotes that the extroverts (High Personality Trait students) had higher attitude towards Basic Science than the introverts (Low Personality Trait Students).

The table further shows that the Female gender had higher mean attitude score (Grand mean (59.06 + .91) = 59.97 than the Male counterpart (Grand mean (59.06 -.97) = 58.09.

4.6. DISCUSSION OF RESULTS

4.6.1. Effects of Brainstorming Strategies on Students' Achievement in Basic Science

The findings of the study revealed that the two brainstorming strategies significantly affected students' attitude and students' achievements in Basic Science. The Freewriting Strategy experimental group obtained highest mean score followed by Questioning Strategy experimental group with the least performance recorded in the Modified Lecture control group. The introduction of treatment in the two experimental groups could have been responsible for the performance of the students. The process of brainstorming which is a reflective learner- centered instructional strategy has helped the students to gain required knowledge to make meaning from information gathered. This is in line with the assertion of Pollard (2005) and Ajitoni (2005) that reflection leads to effective students' learning.

Adewale (2008) also affirmed that brainstorming improves students' achievement, attitudes, maximize intellectual potentials and ability to understand and solve real life problems. .

The conventional Lecture method was also useful as it produced some mean gain. The finding corroborates the study by Adedigba (2004) in which he discovered that the strategy remains a powerful means to communicate information to achieve instructional goals.

4.6.2. Effect of Brainstorming Strategies on Students' Attitude to Basic Science

The obtained result showed that students exposed to the two brainstorming strategies recorded higher mean scores than the control group. The students in Freewriting teaching strategy displayed positive attitudinal change than those exposed to Questioning strategy. Hence, attitudinal Skillwu (2012) and Yara (2009) who observed independently that the attitude of learners can be influenced by the attitude of teacher and their method of teaching. In the same vein, Akinsola and Olowoyeye (2008) also discovered that conventional lecture method is inadequate for improved students' attitude.

4.6.3. Effect of Extraversion Domain of Personality Traits on Learning Outcomes of Students in Basic Science

The result obtained in this study showed that there was no significant main effect of personality traits on achievement and attitude of students towards Basic Science. However, there is a slight difference in adjusted posttest mean achievement score of low (introverts) and high (extroverts) personality traits. The introverts had higher posttest mean achievement score than the extroverts. The extroverts even had greater pretest mean achievement score, so while extroverts had a mean gain of 4.26, introverts had a mean gain of 6.64. The result is in

line with the assertion (1995) that in a non-threatening environment, introverts learn best in quiet, mental reflection.

4.6.4. Effect of Gender on Learning Outcomes of Students in Basic Science

The findings on gender showed that it has no significant effect on achievement and attitude of students to Basic Science. The study has shown that Basic Science is neither a male-dominated nor a female-dominated subject. This finding is in line with the findings of Nsofor (2001) and Asoegwu (2008) who observed that both males and females can do well in Science if exposed to similar learning conditions.

4.6.5. Two-way Interaction Effects of Treatment and Gender on Students' Learning Outcomes in Basic Science

The result obtained showed that the two-way interaction effect of treatment and gender on students learning outcomes was not significant. The implication of this finding is that achievement in and attitude to Basic Science is not affected by gender. The finding therefore corroborate the studies of Akinbobola (2004) and Alake (2007) that discovered that there is no significant difference in students' learning outcomes of both boys and girls achievement and attitude to Basic Science.

4.6.6. Three-way Interaction Effects of Treatment, Personality Traits and Gender on Learning Outcomes of Students in Basic Science

The result obtained indicated that a three-way interaction effect of treatment, personality trait and gender on students' achievement and attitude to Basic Science was not significant. The result supports the findings of a non significance of interactive effect of variables on learning outcome and attitude to Basic Science.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0 Summary of Findings

The findings of the study revealed the following as it concerns the main and interaction effects.

1. There were significant main effects of:
   (i) Treatment on students' achievement in Basic Science.
   (ii) Treatment on students' attitude in Basic Science.
2. There were:
   (i) No significant main effect of extraversion personality trait on students' achievement in basic science.
   (ii) significant main effect of extraversion personality trait on students' attitude to basic science.
   (iii) No significant main effect of gender on students' achievement in basic science.
   (iv) No significant main effect of gender on students' attitude to basic science.
3. There were:
   (i) Significant interaction effect of treatment and extraversion personality trait on Students' achievement;
   (ii) Significant interaction effect of treatment and extraversion personality on the students' attitude;
   (iii) No significant interaction effect of treatment and gender on the students' achievement;

(iv) No significant interaction effect of treatment and gender on the students' attitude;

(v) No significant interaction effect of treatment, gender and extraversion personality trait on the students' achievement;

(vi) No significant interaction effect of treatment, gender and extraversion personality trait on the students' attitude.

There was significant effect of the two brainstorming strategies on Junior Secondary Two students' achievement and attitude towards Basic Science;

The Freewriting Brainstorming Strategy was the most effective, followed by the Questioning Brainstorming Strategy while the Traditional Lecture method was the least;

Gender of respondents had no significant effect on their learning outcomes and attitude;

Personality traits, that is, introverts or extroverts have no significant effect on the achievement but had significant effect on attitude of students;

There was no significant interaction effect of the brainstorming strategies and gender on students' achievements and attitude;

Interaction effect of the brainstorming strategies and personality traits was significant on students' achievements and attitude;

There was no significant interaction effect of gender and personality traits on students' learning achievement and attitude;

Therewas no interaction effects of treatment, personality traits and gender on students' learning outcomes and attitude. This implies that if the same treatment is given to JSS Two students in another state in Nigeria, similar results would be obtained.

5.2.0 Conclusion

The study has established that Brainstorming teaching/learning method with the use of Freewriting and Questioning strategies are effective in improving students' learning outcomes in Basic Science. The strategies were able to improve the achievement, problem solving ability and attitude of both boys and girls to science learning. Students of varying degrees of extraversion and learning styles also interacted positively to influence their learning.

The study has also established that students do not come to the class with a blank mind as demonstrated by their contribution to leaning during treatment which also improved with time.

5.3.0 Recommendations

Based on the results obtained and discussed in this study, the following recommendations are hereby made:

1. Freewriting instructional strategy and Questioning instructional strategy are effective instructional strategies for teaching Basic science at Juniorssecondary school level in Osun state.The use of brainstorming strategies is recommended for teaching at JuniorSecondary School level;
2. Brainstorming strategies such as Freewriting and Questioning are particularly recommended for use because they are easy to use for JuniorSecondary School students as students are active learners. They can also be used at any stage of a lesson that requires contributions of ideas to learning,
3. The personality traits of students cannot be ignored in classroom discussion. Teachers should therefore provide ground rule for any class interaction.

4. All students, irrespective of sex should be given equal opportunity to share ideas during lessons

5.4.0 Suggestions for further Studies

There are many areas of Brainstorming that lend itself to research. This study only used two strategies and there are more to explore. There are also variations of Brainstorming, other than individual brainstorming in this study that need to be investigated.. The study could be replicated in other states of Nigeria and in some other core subjects other than Basic Science. There are some other moderator variables such as home background, students' cognitive styles, and other personality traits that could be investigated.

5.5. Contributions to Knowledge

This study has contributed to knowledge in the following ways:

1. JuniorSecondary School students are capable of reflections.
2. JuniorSecondary School students can contribute ideas to learning given the right environment.
3. Brainstorming can improve achievement of students in Basic Science.
4. Freewriting Brainstorming instructional strategy has a greater potential to improve students' learning outcomes in Basic Science than questioning.

REFERENCES

Abiona, O. F. 2008. Effects of three modes of instruction on students' environmental knowledge, attitudes and skills in solid wastes and sewage management in Biology.PhD Thesis.Department of Teacher Education.University of Ibadan.

Adedigba, T. A. 2004. Effectiveness of two collaborative group strategies in the teaching and learning of some aspects of population education in Nigerian Colleges of Education.An Unpublished Ph.D Thesis, University of Ibadan, Ibadan.

Adeniran, I. A. 2009. Difficultiesin educational opportunities and women disempowerment in Nigeria. A paper presented at the 4th in Africa and Africa Diaspora International Conference held in Abuja July 3-8.

Adeniyi, E.O. 2007. Introduction: 9-Year Basic Education Curriculum. Basic Science for Junior Secondary 1-3. Nigeria: NERDC.

Adepitan, J. O. 2003. Pattern of enrolment on physics and students' evaluation of the contributory factors on Colleges of Education.*African Journal of Educational Research*. 2: 136-146.

Adesoji, F. A. 2002. Rethinking the Science Curriculum. In Ajala J. A. (ed). *Designing content ofthe Curriculum*. Ibadan: Printmarks Ventures.

Adesoji, F. A. 2008. Students' ability and effectiveness of problem-solving instructional strategy.*Kanla-Ra. Journal of Social Science*, 17.1: 5-8.

Adesoji, F.A. and Babatunde, A. G. 2005.The importance of verbal and non-verbal communication books.In A.Dada., A., Abimbade, and O.O. Kolawole, (Eds), *Issues inLanguage, Communication and Education*. Ibadan: Counstellation Books. 371-384.

Adewale, I. G. 2008. Effect of brainstorming on students' achievement in junior secondary school Mathematics- an effort in making schools effective. *Journal of Sociology and Education in Africa*.7.1: 203-217.

Afuwape, O. M. and Oludipe, D. I. 2008.Students' self-concept and their achievement in basic science.*Educational Research and Review* 3.7: 242 – 245.

Agbayewa, J. O. 2000. *Comparative effects of three problem solving strategies* on Students' Heuristic Transfer- Secondary School Physics. *Ikere Journal of Science* Education. 1.1,33-40.

Aina, J. K. 2013. Challenges and Prospects of Primary Science teaching in Nigeria.Continental Journal of Educational research, 5(2).32-37.

Ajibola, A. 2008. Innovation and curriculum development for basic education in Nigeria – Policy, Priorities and Challenges of Practice and Implementation. Research Journal of International Studies. (8), 51 – 58.

Ajitoni, S.O. 2005. Reflective teaching: approach and benefits. Being a text paper presented at the National Convention of Colleges of Education workshop.

Akinbobola, A. O. 2004. Effects of co-operative and competitive learning strategies on the performance of students in physics. Journal of Research in Education. 1. 1. 71-75..

Akinboye, J.O 2007.Value-Added Education for Nigeria.In J. A., Nwazuoke, E. A.Okediranand O. A. Moronkola,. (Eds). *Education for Social Transformation. Ibadan*: University of Ibadan Printers. (1-20).

Akinsola, M. K. andOlowojaiye, M. B. 2008. Teacher instructional methods and students' attitude towards Mathematics.*International Electronic Journal of Mathematics Education.*3.1: 60-73.

Akpan, E.U.U. 2008. An analysis of classroom, poor teaching method interaction of SSS Chemistry Teachers in IkotEkpere local government area of AkwaIbomStateNigeria, *Journal of Science Teachers Associationof Nigeria*. 43.1-2: 16 – 22.

Akpan, B. B. 2010. Innovation in Science and Technology through Science Teachers' Association.*Science Education International* vol. 21. (2).

Alake, E. M. 2007. Utilization of floor puzzle in improving NCE students achievements in integrated science concepts. Proceedings of the 48th Annual Conference of STAN 150 – 155.

Allport,G. W. and Odbert, H. S. 1936. Trait names: A psychological study. Psychological Monographs. 47. 211.

Allport, G. W. 1937. The functional autonomy of motives.*American Journal of Psychology*. 50. 141-156.

Anderson, L. W. and Krathwohl, D. R. 2001.Ataxonomy for learning, teaching and assessing: A revision of Bloom's taxonomy of educational objectives. New York, USA: Addison-Wesley Longman.

Anekwe, J.U. and Obi, R.O. 2009.Restructuring secondary school curriculum.*Journal of Curriculum Organization of Nigeria*. 16.

Armstrong, N. 2006.Brainstorming strategies Retrieved June 2013 from file: www.3.ccsudh.edu/.te/dow/brainstorming.strategies.pdf.

Arthur, T.M. and Bethel, L.M. 1999. Teaching Strategies Designed to AssistCommunity College Science Students' Critical Thinking". *Retrieved from* http:/www.ed.psu.edu/

Asoegwu, A.O. 2008. Effects of Demonstration on students' achievement in senior secondary school geography.*Journal of Science Teachers Association of Nigeria* 43 1 and 2.

Awodeyi, A.F. 2005. The Constructive approach to teaching relationship between volume and capacity in school Mathematics. *JSTAN* 40. 1 and 2: 21-27.

Bamidele, L. 2004. Students' poor performance in Physics: A blame to our nation's technological development. Nigerian Journal of Science and Practice. 2 (1), 174-180.

Balogun, T. A. Gender issue in the teaching of Science, Technology and Mathematics. In Erinosho, S. Y. (ed). Perspectives on women in science and technology in Nigeria. Nigeria: Sam Bookman and Communication series. 47-51.

Bilesanmi-Awoderu, J. B. 2006. Effect of computer-assisted instruction and simulation/games on the academic achievement of secondary school students' in biology.*Sokoto Educational Review* 8.1: 49 – 60.

Bolaji, S. 2007. Evaluating creativity in Nigerian education: a conference presentation at philosophy of education society of Australia.

Burt, C. 1964. The Act of Creation. New York: Macmillan Publishing company.

Byrne, B. 1990.Self-concept and academic achievement investigating their importance of discriminators of academic trade membership in high school.*Canadian Journal of Education* 15.2: 173 – 182.

Cain, S., 2013.*The power of introverts in a world that can't stop talking*.Crown Publishing.Scientific American.

Caram, L. and Davis, T. 2005. Instructing Students' Engagement with Questioning. Kappa-Delta . Pi Record.

Chae, K. 1977. Alex Osborn Homepage. Retrieved October 18,1999 from http/uts.cc.utexas.edu/-chaekm/afosborn.htm.

Chukwueke, B.U. and Chikwenze, A.R. 2012.Reform in integrated science curriculum in Nigeria- challenges and prospects.*Journal of Research and Development*.4: 1.ci/journal/1999 AECTS Arburn Bethel tf.

Corelle, L.C. 2004. Brainstorming reinvented: a corporate communications guide to ideation. New Delhi: Response.

Costa, P.T. and Mcrae, R.R. 1992. Age difference in personality structure: a cluster analytic approach. *Journal of Gerontology*. 31.5:564-570.

Cotton, K. 1991. Teaching Thinking Skill. North Western Regional Educational Laboratory school improvement research services. http://:www.learn.org//workshop.social studies.

Davis, E. and Linn, M.C. 2000.Scaffolding students' knowledge integration through prompts for reflection.*International Journal of Science Education*. 22.8: 819-838.

Delbecq, A.L and Vandeven , A.H 1971. A group process model for problems Identification and Program Planning.*Journal of Applied Behavioural Science.* vi. 466 – 91

Dewey, J. 1959. Psychology and social practice: contribution to education .Chicago, IL University of Chicago Press.

Dewey, J. 1997a.*Experience and education*. Macmillan.

Dewey, J. 1997b. *How we think.* New York: Dover Publications.

Diehl, M. and Stroebe. 1991. Productivity loss in idea-generating groups: Tracking down the blocking effect. *Journal of personality and social psychology*. 61. (3).

Digman, J. M. 1990. Personality Structure: Emergence of the Five-factor model. *Annual Reviewof Psychology*. 41. 417-440.

Ebert, S., Ebert, C. and Bentley, M. L. 2011.Questioning strategies in the classroom.*Corwin: The Educator's Field Guide*.education.com.

Eniola, M. S. and Adesoji, F. A. 2001. Essential ingredients for Teaching Science Effectively to the visually impaired Students at the Secondary School level in Nigeria. *Journal of Applied Psychology*. 1 and 2:209-213.

Erinosho, S. Y. 2008. Teaching Science in secondary schools- a methodology handbook.. Nigeria: African Cultural Institute.

Erinosho, Y.E. 1997. The making of Nigerian women scientists and technologists.*Journal of Career Development.*Columbia. 71-80.

Erinosho, Y.E. 2005.Women and science.36th Inaugural Lecture, OlabisiOnabanjo University, Ago-Iwoye.

Erickson, H.L. 2007. Concept-based curriculum and instruction for the thinking classroom. Thousand Oaks, CA: Cornin press.

Fakayode, A. 2005. Teaching for creativity: the missing gap in curriculum implementation. In A. Dada, A.Abimbade and O.O. Kolawole. Eds. *Issues in language, communication and education*. Ibadan: Counstellation Books. 455-465.

Federal Ministry of Education (FME).2004. *National policy on education* (Revised). Lagos: NERDC Press.

Federal Ministry of Education. 2007. A year basic education curriculum: basic science for JSS 1-3. NERDC.

Fensham, P. 2002. Time to change drivers for scientific literacy.*Canadian Journal for Mathematics and Technology Educatio*n. 2:9-24.

Ferris, D. and Hedgcok, J. 2005. *Teaching ESL Composition: purpose, process and practice*.2nd Edition. Lawrence Erlburn.

Field, D. and Millsap, R.E. 1991. Personality in advanced old age: continuity or change? *Journals of Gerontology*. 46: 299 – 308.

Fisher, R. 2007. *Teaching children to learn.2nd edition.*Cheltenham.Stanley Thornes.

Fleming, G.. 2013. Brainstorming techniques. .homeworktips.about.com.od/homework help/brainstorming.htm.

Franken, R. 1994. *Human motivation*. (3rded). Pacific Grove. CA: Books/Cole Publishing Co.

Gbolagade R.O. 2009. The impact of constructive model based training programmes on pre-service teacher knowledge, attitude, classroom practice and students' teaching outcome in Junior Secondary Mathematics. An unpublished Ph. thesis, University of Ibadan, Ibadan.

Goldberg, L. R. 1971.. A historical survey of personality scales and inventories. P. McReynolds. Ed. *Advances in psychology assessment* Palo, Alto, CA: Science and Behaviour Books. 2: 293 – 336.

Gosling, S. D; Rentfrow, P.J. and Swann, W.B. 2003. A very brief measure of the Big Five Personality Domain.*Journal of Research in Personality*. 37.6:504-528.

Haddou, H. A. Camilleri, G. and Zarate, P. 2014. Predication of ideas number during a brainstorming session.*Group Decision and Negociation*. 23. (2).

Halverson, C.F.,Kohnstamm, G.A. and Martin, R.P. 1994. The developing structure of temperament and personality form infancy to adulthood. Hillsdale, NG: Eribaum.

Hamza, F. and Umaru, M. 2011. Way forward for the new Basic Science and Technology. *Journal of Science Teachers' Association of Nigeria.*

Harris, E. 2002.Creative thinking technique. Retrieved from file: //E:/Creative%20 Thinking%20 Technique:htm. Version date: January 5, 2002.

Heinstrom, J. 2000. The impact of personality and approaches to learning on Information Behaviour.Information Research 5. (3).

Helson, R. and Steward, A. 1994.Personality change in adulthood.T.F. Hertherson and J.L. Weinberger. Ed. *Can personality change?*WashingtonDC: American Psychological Association.

Henningsen, D. D. and Henningsen, M. L. M. 2013. Generating ideas about the uses of brainstorming: Reconsidering the losses and gains of brainstorming groups relative to nominal groups. Southern communication Journal. 78. (1). 42-55.

Hyman, R.H. 2003 and Risio, 2006.Questioning in the College Classroom.i*Classroom Communication*. Eds. Neff and Weiner 73-88.

Ige, T.A. and Arowolo, J.G. 2005.Effects of hypothetico – Deduction Approach in JSS III Students Achievement in Integrated Science.JSTAN, 38. 1 and 2: 39 – 45.

Itamah, D. 2007. Functional science and technology mathematics education for national development. A Keynote Address at National Conference of Federal Colleges of Education.

Iroegbu, T. O. 2012. Explaining Hands-on Investigations, Procedures and Paradigms from Waves and Optics.*African Journal of Educational Research.* 6 (1 &2), 51-56.

John, O.P. 1990. The 'big five' factor taxonomy: Dimension of personality in the natural language and questionnaires. L.A. Peniun Ed. *Handbook of personality: theory and research*. New York Gullford Press.

John, O.P. Hampson, S.E. and Goldberg, L.R. 1991. Is there a basic level of personality description? *Journal of Personality and Social Psychology*.60: 384 – 361.

Jung, J. 1921. Psychological Types. Zurich: Rascher, Verlag.

Jung. J. 1995.*Memories, dreams, reflections*. London. Fontana Press. 414 – 415.

Kasin, S. 2003. *Psychology*. USA: Prentice Hall.

Keeves, J.P. and Morgarstain C. 1992. .Attitudes towards Science III: Changes in Science Education and Achievement, 1970-1984. New York: Pergamon.

Kelly, G.A. 1991. *The psychology of personal constructs: volume one – a theory of personality.*London. Routeledge.

Kennedy,H.L. 2000. Society cannot continue to exclude Women from the field of Science and Technology. *Mark Education*. 120. 3.

Klimstra, T. 2010. Personality trait and educational identity formation in late adolescence longitudinal association and academic progress.Journal of Youth and Adolescence. 41. 341-356.

Kohn, N. and Smith, S. 2011. Collaborative fixation effects of others' ideas on brainstorming.Applied cognitive psychology.25 (3).

Kolawole, E.B. 2007. Effects of competitive and cooperative learning strategies on academic performance of Nigerian students in mathematics.*Educational Research Review* 3.1: 33 – 37.

Komarraju, M., Karau, S.J.,Schmeck, R. R. and Avdic, A. 2011. The Big Personality Traits: Learning styles and academic achievements, personality and individual differences. 51(4) 472-477.

Lampert, M. 2001. Teaching problems and the problem of teaching.New Haven: Yale University Press.

Maharjan, S.P. and White, P.A. 2000. Promoting students' science and technology thinking: developing skills and attitudes concerning our environment. Katmandu: ER11

Mayer, R. 1992. "Should there be a 3-strikes rule against pure discovery learning? The case for guided methods of Instruction".*American Psychologists* 59: 14-19.

McAdams, D.P. 1995. What do we know when we know a person? *Journal of Personality*. 63: 365 – 396.

McCrae, R.R. and Costa, P.T. 1990.*Personality in adulthood*. New York: Guilford Press.

..

Mischel, W. (1968).Personality and Assessment. London: Wiley.

Moronkola, O.A., Akinsola, M.K. and Abe, C.V. 2000.*The Nature of Curriculum*. Ibadan: Royal People

Nichol, M. 2012. Five brainstorming strategies for writers.Retrieved from: www.daily writingtips.com/5-BS-strategies-for writers/.2012.

Nigerian Educational Research and Development Council. 2007. *9-year basic education curriculum.* Nigeria: Federal Ministry of Education.

Nsofor, C. C. 2001. Cultural impediments on women in STM education.*Science Teachers'Association of Nigeria conference proceedings*. August 20-25.

Nzeribe, A. C.B. 2004. *Introduction to philosophy of childhood education*.Yola, Nigera: Pleasant places publishing company.

Nwosu, A.A. and Nnewi, U.M. 1997. Teachers' knowledge and application of innovative strategies in biology teaching.

Obianyo, B.N. 2000. Career choice and gender stereotyping in science.paper presented at a national conference on gender equality in Nigeria.Umunze, Federal College of Education.Umunze 13-16, June.

Obioma, G. 2005."Educational Assessment in the culture of reform". Context paper presented at the 31st annal conference of the International Association for Educational Assessment (IAEA) held at the Nicon Hilton Hotel, Abuja. September 4-9, 2005.

Obioma, G. 2006. 9-*year Basic Education Curriculum*.NERDC.Abuja Nigeria.

Obioma, G. 2007. The role of teachers in the implementation of UBE in Nigeria. Paper presented at the 47th Annual Conference of STAN in Calabar.

Odogwu, H.N. 2002. The mathematics teacher-factor in the achievement of the goals of the Universal Basic Education.*The Journal of the Mathematics Association of Nigeria*.(ABACUS) 27.1: 72-79

Oduwaiye, J.O. 2009. Impact of computer-assisted and programmed instruction on pre-service teachers' learning outcomes in some Environmental concepts in Biology.Unpublished PhD Thesis.University of Ibadan.

Offorma, G.C. 2005. Curriculum for wealth creation. Paper presented at seminar of the World Council for Curriculum and Information. Kano. October 25th.

Ogunkola J.B. and Bilesanmi-Awoderu, J. B. 2002.Effects of laboratory and lecture methods on students, achievement in Biology. *African Journal of Education* 5.2: 247-260.

Ogunleye, B.O. 2009. Evaluation of the environmental aspect of the senior secondary school Chemistry curriculum in Ibadan. Unpublished Ph.D. thesis. Faculty of Education, University of Ibadan,Ibadan.

Ogunmade, T.O. 2006. The status and quality of secondary school science teaching and learning in Lagos State Nigeria.An Unpublished Doctoral Thesis. Edith Cowan Unc `iversity, Perth, Western Australia.

Ojebisi, A.O. 2010. Science education reform in Nigeria for national development: Challenges and the Way Forward. www.cyberessays.com.

Ojimba, D. P. 2013. Science Education Reforms in Nigeria: Implications for Science Teachers. *Global Advanced Research Journal of Peace, Gender and Development Studies*. 2 (5).86-90

Oladejo, M. A., Olosunde, G. R., Ojebisi, A. O. and Isola, O. M. 2011. Instructional materials and Students' achievements in Physics: some policy implications. *European Journal of Humanities and Social Sciences.2 (1).*

Olagunju, A. M. 2000. Enhancing girls' participation in science. In S.O. Ayodele (ed). *Teaching strategies for Nigerian secondary schools*.187-204.

Ojo, A.J. (2003). Relative effectiveness of self-regulatory and cognitive learning strategies on learning outcomes in SSS Mathematics.Unpublished Ph.D Thesis, University of Ibadan, Ibadan. .

Okedeyi, A. S. ,Ogunwale, T. O. 2013. Oginni, A.M. and Bureimoh, D. S. 2O13. Nigerians sience teachers perception of effective science teaching and their classroom practices in JSS in Lagos state, Nigeria. Journal of Education and Practice.Vol. 4, no. 25.

Okeke, E.A.C. 1996. Women and girls participation in science, technology and mathematics: educators as facilitators. *A Lead Paper Presented at the 8th Conference of Nigeria Academic of Education,* Enugu 19-21 November, 1996.

Olaniyi, F. O. 2009. Effect of Jigsaw I and Group-Investigation cooperation learning models on pre-service teachers in selected environmental concepts in Integrated science. Unpublished Ph.D.thesis of Department of Teacher Education, University of Ibadan.

Olanrewaju, A.O. 1994. New approaches to the teaching of integrated science.Alafas Publishing Company.

Olatoye, R.A. and Afuwape, M.O. 2004.Emergent issues in enhancing the teaching and learning of science in schools.Afenike, O.A. and Adewale, J.D. Eds. *Issues in Educational Measurement and Evaluation in Nigeria*. Institute of Education, University of Ibadan, Ibadan

Olatundun, S.A. 2008. Impact of outdoor activities and educational activities on pupils' environmental knowledge and attitude in selected primary schools in Ibadan.Unpublished Ph.D Thesis, University of Ibadan.

Oludipe, D.I. 2012.Gender differences in Nigerian Junior Secondary Students' academic achievement in basic science.*Journal of Educational and Social Research*. 2.1.

Omoifo, C. N. 2012. Dance of the limits. Reversing the trends in science education in Nigeria.Inaugural lecture, University of Benin, Benin City.

Omorogbe, E. and Ewansika, J. C. 2013.Academic Journal of Interdisciplinary Studies.vol 2. No 7.

Onose, G. M., Okogun, E. A. and Richard, J. 2009. Reforms and innovation in training and re- training of science and mathematics teachers to meet with challenges of global development.Journal of Teacher Perspective. 3. (2).

Opara, J. A. 2014. Understanding the notion of the Nigerian science teacher for sustainable development.*Meditteranean journal of Social Sciences*. 5. (26). 101-106.

Opara, J. A. 2015. Resource utilization for teaching basic science in Nigeria: Implication for curriculum innovation and change. Research journal of Education in Asia. 1. (1).

Osborn, A. F. 1941. History and use of brainstorming.www.brainstorming.co.uk. 1997-2021. Infinite Innovation Ltd. Retrieved 21st January, 2014.

Osborn, A.F. 1952a. *Wake up your mind: 101Ways to develop creativity*. New York: Scribners.

Osborn, A.F. 1952b. *Your Creative Power*: *How to use imagination*. New York: Scribners.

Osborn, A. F. 1962. Development in Creative Education.In S. J. Parnes and H. F. Harding.(eds). *A source bookfor creative thinking*. New York: Scribners

Osborn, A. F. 1953, 1963.*Applied Imagination: Principles and Procedures of Creative ProblemSolving*. New York: Charles Scriber.

Owoyemi,T.C. 2007. Mathematics and Chemistry Senior Secondary School Certificate results, gender and attitude as predictors of achievement in a physical Chemistry course.*African Journal of Educational Research.* 11. 18.

Oyediran, A.M.and Agoro, A.A. 2004.A Multimedia Approach to the Teaching Some Difficult Topics in Integrated Science. JSTAN Dec. 39.1 and 2:108-112.

Papert, S. 1980. Mindstorms: Children, computers and powerful ideas. New York: Basic Books.

Pandian, S.S. 2004.*Cooperative learning biology: the effect of computers*. Department of Education, Arunachi University,India.

Pervin, L.A. 1994. A critical analysis of current traits theory. *Psychological Inquiry*. 5: 103 – 113.

Piaget, J. 1977. *The development of thought equilibration of cognitive structures*.(A Rosin. Trans.) New York: The Viking Press.

Piaget, J. 1964. Development and Learning.*Journal of Research in Science Teaching* 2.3: 176-851.

Pollard, A.2005. Reflective Teaching. (2nd edition)..London: Continuum.

Polman, J. L. 2000. Designing project-based science: Connecting learners through guided inquiry. New York: Teachers College Press.

Poropat, A.E. 2009. A Metaanalysis of the five factor model of personality and academic performance.*Psychological Bulletin.*

Rajendran, N. 2000.Teaching higher order thinking skill in classroom. http://www.hongkongforum/2000htm.

Rich, J. 2006. Brainstorming,*Brainstorming.Co.UK*.

Rickards, T. 1999. Brainstorming.In Runco, M. A. and Pritzker, S.R. Eds.*Encyclopedia ofCreativity*. San Diego, Calif: Academic Press. 1: 219-228.

Risio, S. 2006.Questioning Techniques.Retrieved from http://www.utoronto.ca/tap/resouces/index.html.

Savery, J.R. and Duffy, T. M. 1995. Problem based learning: An instructional model and its constructivist framework. *Educational Technology.* 35. (5). 31-38.

Samuel, W.W. and John, G.M. 2004.Effect of cooperative class experiment teaching method on secondary school students' chemistry achievement in Kenya's Nakuru, District.*International Education Journal* 5.1: 26 – 35.

Sawyer, K. 1995.The creative power of collaboration.Journal of the learning sciences.Vol 4. No 3. 321-354.

Seireg, L. (1996).Optimal design of a journal bearing.Cohter. Eds. *Strategies for effective thinking – a handbook for effective teaching* ,Wisconsin-University of Wisconsin.

Sodipo, F. 2009. The new junior and secondary school curricular.Hopes and challenges. Paper Presented at the Mandatory Continuing Professional Training (MCPOT) Workshop for Principals of Secondary Schools in the South-West Geopolitical zone 3.

Tahir, G. O. 2008. Federal Government intervention in Universal Basic Education.*UBE forum: A Journal of Basic Education in Nigeria*.

Tan, K. S. 2002. Reflective learning in the classroom. REACT. Vol. 21. No 2. 101-109. Nanyan Technological University and National Institute of Education, Singapore.

Tate, M. L. 2010.” Workshops don’t grow dendrite”.*20 instructional strategies that engage the brain.*2nd edition.Thousand Oaks C.A Corwin.

Thompson, E. R. 2008. Development and validation of an international English big five mini-markers.*Personality and Individual Difference*. 45.(6).542-548

Twomey, F.C. 1989. *Enquiring teachers, enquiring learners.A constructive approach for teaching*. New York: Teachers College Press.

UNESCO, 2004.*Education for all.* The Quality Imperative, EFA. Global Monitoring Report.

Vogel, T., Bohner, G. and Wanke, M. 2014. Attitudes and attitude change. Pschology Press.

Vygotsky, L. 1978. *Social constructivist theories*.Retrieved Feb 2012 from http//www.ppstate.edu/vybio.htm.

Watson, S. 2012. How to brainstorm.Retrieved from: specialed.about.com/ed/teacher strategies/a/brainstorm.htm.

Wood, E. J. 1993. Problem-based learning.Biochemical Education. 21. (4). 169.

Wood, W. 2000. Attitude change: Persuation and social influence. Annual review of psychology. 51. 539-570.

Yoloye, E.A. 1998. The Meaning of Science and the Teaching of Science. S.Y. Erinosho Ed Science Education in Nigeria: which way Forward? *Proceedings of Seminar Supported by FAWE,* Ibadan 7-13.

Yoloye, T.W. 2004. That we may Learn Better. An Inaugural lecture delivered at University of Ibadan. Ibadan: University of Ibadan Press.

Zhang, L. and Huang, J. 2001. Thinking styles and the five factor model of personality. European Journal of Personality. 15, 465-476.

APPENDIX I

NOTES OF LESSONON SOURCES OF ENERGY

Appendix Isa- Freewriting Brainstorming Instructional Strategy

Theme: You and Energy

Topic: Energy

Class: JSS II

Subject: Basic Science

Average Age of Students: 13 years

Problem statement: What are the sources of energy?

What is Energy?

Duration: 40 minutes

Previous Knowledge:

(i) Characteristics of living things

(ii) The ability of living things and non-loving things to do work

Learning outcomes: This lesson will work towards the following learning outcomes

(i) Communicate ideas and information

(ii) Apply various strategies to generate and shape ideas on energy

(iii) Use various scientific processes to prompt and generate ideas on energy

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

- Explain what energy is
- Describe what energy can do
- Identify sources of energy
- State the relationship between energy and work

Instruction materials: pictures of

- Athlete running

- Men pushing a car
- Boys playing football
- Some men hoeing
- A blown off building

Presentation:

Step I: Teacher interacts pleasantly with students. May re-arrange the seating condition, Group student; make student lively and ready to learn

Step II: Let students state the characteristics of living things such as movement, nutrition and respiration.

Step III: Write up the topic for the day as problem statement.

What is Energy?

What are the sources of energy?

Step IV: Brainstorming session

(i) Teacher distributes the pictures to individual, pair or group (depending on the number of material available)

(ii) Teacher states the ground rules

These may include:

- Students are to work individually/group
- Maintain absolute silence
- Do not disturb each other

(iii) Teacher gives the guidelines the activities. These may include:

- Give as many answer as possible
- Do not criticize others
- Write down every ideas that comes to your mind;

You only have 5 minute to do the, after which the teacher will collect all material

(iv) Teacher goes round to encourage students without noise or threat.

Activity: What is Energy?

S/N	PROBING QUESTIONS	STUDENT ACTIVITIES	POSSIBLE IDEAS
1	What activities can you see from the picture	Observation and recording	A man running A man sweating
2	What does he need to be able to run?	Determining cause and effect relationship	Food, Power, Energy, Legs
	How would he feel after running 5 minute	Determining cause effect relationship	Tired, Thirty Hungry
4	What will he need to run a gain?	Determining cause and effect relationship	Food , energy, power, glucose
5	Why do you give glucose to athletes during sport	Application of ideas	To gain energy, to get power

Step V: **Generalization**

Teacher collects all pictures. Direct attention of students to the activities and ask for what is needed to perform the different activities.

Answer - energy (power, strength)

Teacher generalized that the activities are regarded as WORK and to do work, they need **ENERGY**. Therefore energy is the ability to do work. The energy comes from different sources such as sunlight, Chemical, (food, kerosene, and wood) electricity students mention other types of work they are familiar with and their source of energy

Step VI: Teacher reads out some ideas written by students and pick out related ideas

Step VII: provide for repetition of learning by stating the important ideas in a blackboard summary.

Step VIII: Evaluate progress of each student. Collect individual material and motivate student with encourage for further attempts at brainstorming.

Step IX: Assignment

Write five example of work at home and the source of energy for such activities.

APPENDIX IB

QUESTIONING BRAINSTORMING STRATEGY

AVERAGE AGE OF STUDENT: 13 years

DURATION: 40 minutes

TOPIC: What are the sources of energy?

PREVIOUS KNOWLEDGE:

Characteristics of Living Things

Ability of living things to use energy

LEARNING OUTCOMES:

The lesson will work towards the following learning outcomes:

- Communicate ideas and information
- Use various scientific and mental processes to generate ideas on energy.

BEHAVIOURAL OBJECTIVES:

- At the end of the lesson, students should be able to:
- Explain what energy is.
- Describe what energy can do.
- Identify sources of energy.
- State relationship between energy and work.

INSTRUCTIONAL MATERIALS:

Variously shaped small cardboards on which question pertinent to the topic are written

Materials to write on

PRESENTATION:

STEP I: Maintain good friendly teacher- student relationship. Provide ice breaker

STEP II: Lead students with questions to review previous lesson

STEP III: Write up the topic of the day as problem statements

- What is energy?
- What are the sources of energy
- What are the forms of energy
- What can energy do

STEP IV: Brainstorming session

- Teacher distributes the written questions to each student
- It's hard to jump, kick or march on an empty stomach. What is lacking?
- What can energy help you do?
- Where can we get energy to run?
- Do we use all our energy at once?
- Teacher gives instruction on what to do with the questions. The instruction may include:
- Give as many answers as possible to the questions
- Write down every idea that comes to your mind;
- You only have 5 minutes to do the work after which the teacher will collect the materials
- Teacher goes round to encourage students to be effective participants without interruption or threat.

STEP V: Teacher collects written materials.

- Through discussion, teacher presents ideas generated according to categories as related to the concept.

STEP VI: Teacher provides opportunities for repetition of learning by stating the important ideas in an organized form as blackboard summary.

STEP VII: Evaluation: Teacher observes students' participation as discussion progresses. Materials collected from students are evaluated after the lesson.

APPENDIX 1C

CONVENTIONAL LECTURE METHOD

Class: JSS I I

Average Age of Students: 13 years

Duration: 40 minutes

Topic: Sources of Energy

Previous Knowledge: Characteristics of Living Things

Ability of living things to use energy

BEHAVIOURAL OBJECTIVES:

At the end of the lesson students will be able to:

- Explain what energy is?
- Describe what energy can do?
- Identify sources of energy?
- State relationship between energy and work.

INSTRUCTIONAL MATERIALS:

- Chalk, chalkboard
- Various charts and posters showing sources of energy

PRESENTATION:

STEP I: Teacher is welcomed to the class and asked students to sit down

STEP II: Teacher through discussion reminds students of the major ideas from the previous lesson.

STEP III: Teacher writes up the topic of the day

STEP IV: Teacher explains the meaning of energy as the ability to do work. He/she draw example from the activities of students in the class using energy to write, talk sit e.t.c.

STEP V: Teacher explains the different forms of energy such as:- Kinetic energy as energy of motion. Potential energy as stored energy and other identified ones.

STEP VI: Teacher displays pictures of sources of the different forms of energy, periodically asking questions from students and students may also ask questions.

STEP VII: Teacher summarizes the ideas of the lesson and write on the blackboard summary for student to copy down in their notebooks.

STEP VIII: Teacher asks students to read about the importance of energy from home.

APPENDIX II

NOTE OF LESSON ON WATER CYCLE

Appendix IA- Freewriting Brainstorming Instructional Strategy

Theme: Living and Non- Living Things

Topic: Natural Cycles

Class: SS1

Subject: Basic Science

Average age of students: 13 years

Topic: How is water maintained in the atmosphere?

Duration: 40 minutes

PREVIOUS KNOWLEDGE:

- Sun, as ultimate source energy
- Energy flow
- Importance of water

LEARNING OUTCOMES:

- The appreciation of nature to keep water in regular supply
- The identification of the various natural processes involved in water cycle

BEHAVIOURAL OBJECTIVES:

At the end of the lesson. The students will be able to explain the terms water cycle, precipitation, condensation, cloud and evaporation

Draw the water cycle

STEP I: Teacher introduces ice breaker to ease the tension in the class

STEP II: Review previous lesson

STEP III: Write up to the day's lesson as problem statement.

How is water maintained on earth?

STEP IV: Brainstorming session

- Teacher distributes sketch of water cycle to each students.
- States the ground rules such as
- Do not disturb anybody
- Work quietly on your own
- Teacher states that instruction to follow:
- Students are free to write freely on whatever is observed on the picture within five minutes.
- Students are to show with arrows how water moves between the earth's surface and atmosphere
- Name the processes involved.

STEP IV: Teacher collects students written inputs, quickly read out some of their ideas and identify key issues.

STEP V: Teacher engage students in discussion to clarify issues and record salient point as blackboard summary.

STEP VI: Students record the blackboard summary in their notebooks.

EVALUATION: Teacher evaluates students written ideas after lesson

ASSIGNMENT: What can happen if there is no sun on earth?

Diagram of Water Cycle to teach freewriting strategy

APPENDIX IIB

QUESTIONING BRAINSTORMING INSTRUCTIONAL STRATEGY

Topic: Natural Cycles

Theme: Living and Non- Living Things.

Living processes like respiration, excretion

Class: JSS1 A

Average Age of students: 13 years

Duration: 40 minutes

Problem Statement:How is water maintained in the atmosphere?

Previous Knowledge:

- Sun, as source of earth's energy
- Energy flow
- Importance of water

Learning Outcomes:

The lesson will work towards the following learning outcomes:

- The appreciation of nature to keep in regular supply
- The identification of the various natural processes involved in water cycle

Behavioural Objectives:

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

- Explain the terms: water cycle, condensation, clouds, and evaporation
- Create their own terrain to connect concepts of precipitation, condensation and evaporation.

Instructional Materials:

- Question written on papers
- Markers, papers

Presentation:

STEP I: Arrange students in group of three or four

STEP II: Review previous lesson

STEP III: Write up the day's lesson as problem statements.

How is water maintained on earth?

STEP IV: Brainstorming session

Teacher distributes questions to each group

Teacher instructs students on how to interact with the question

The instruction may include:-

- Read all the questions carefully
- Answer all questions with as many answers as possible
- Record all ideas that come to your mind
- No discussion or interruption

Teacher goes around to encouraging students to work on the questions

STEP V: After stipulated time, teacher collects the written materials. The teacher engages students in discussion by going over the question again

STEP VI: Teacher writes the ideas in an organized form as blackboard summary.

EVALUATION: The materials collected from students are evaluated after the class lesson.

Brainstorming Questions On Water Cycle

When rain falls, where does the water go

What are some of the ways by which water is used by?

- Plants
- Animals

In what ways is water released into the atmosphere by:

- Plants
- Animals

(4) What are the forms in which water can exist?

(5) Draw a diagram to show how water gets to land and used by plants and animals.

(6) Identify the features labeled A - G

(7) How is water returned back to the atmosphere?

(8) Use arrows to join the processes.

Diagram of Water Cycle To teach questioning strategy

APPENDIX IIC

NOTE OF LESSON USING CONVENTIONAL LECTURE METHOD

THEME: Living and Non- Living things

TOPIC: Natural Cycles

CLASS: JSSIC

SUBJECT: Basic Science

AVERAGE AGE OF STUDENTS: 13 years

Topic : Water Cycle

DURATION: 40 minutes

PREVIOUS KNOWLEDGE:-

- Sun, as source of energy
- Energy flow
- Importance of water

BEHAVIOURAL OBJECTIVES:

At the end of the lesson the students will be able to:

- Explain the terms _ Water cycle, precipitation, condensation, cloud,
- Draw a water cycle

INSTRUCTIONAL MATERIALS

- Chalk, chalkboard
- Chart of water cycle

PRESENTATION:

STEP I: Teacher maintains silence in the class

STEP II: Through discussion, the teacher reviewed the previous lesson

STEP III: Teacher writes up the topic for the days as water cycle.

STEP IV: Teacher ask students to the importance of water and why it should be in regular supply.

STEP V: Teacher displays the chart showing the water cycle and explains how water move between the earth's surface and the atmosphere which is water cycle.

STEP VI: Teacher explains the various terms involved in water cycle.

STEP VII: Students draw the water cycle in their notebook and also write blackboard summary.

STEP VIII: Teacher gives assignment that students should learn the basic concepts water cycle.

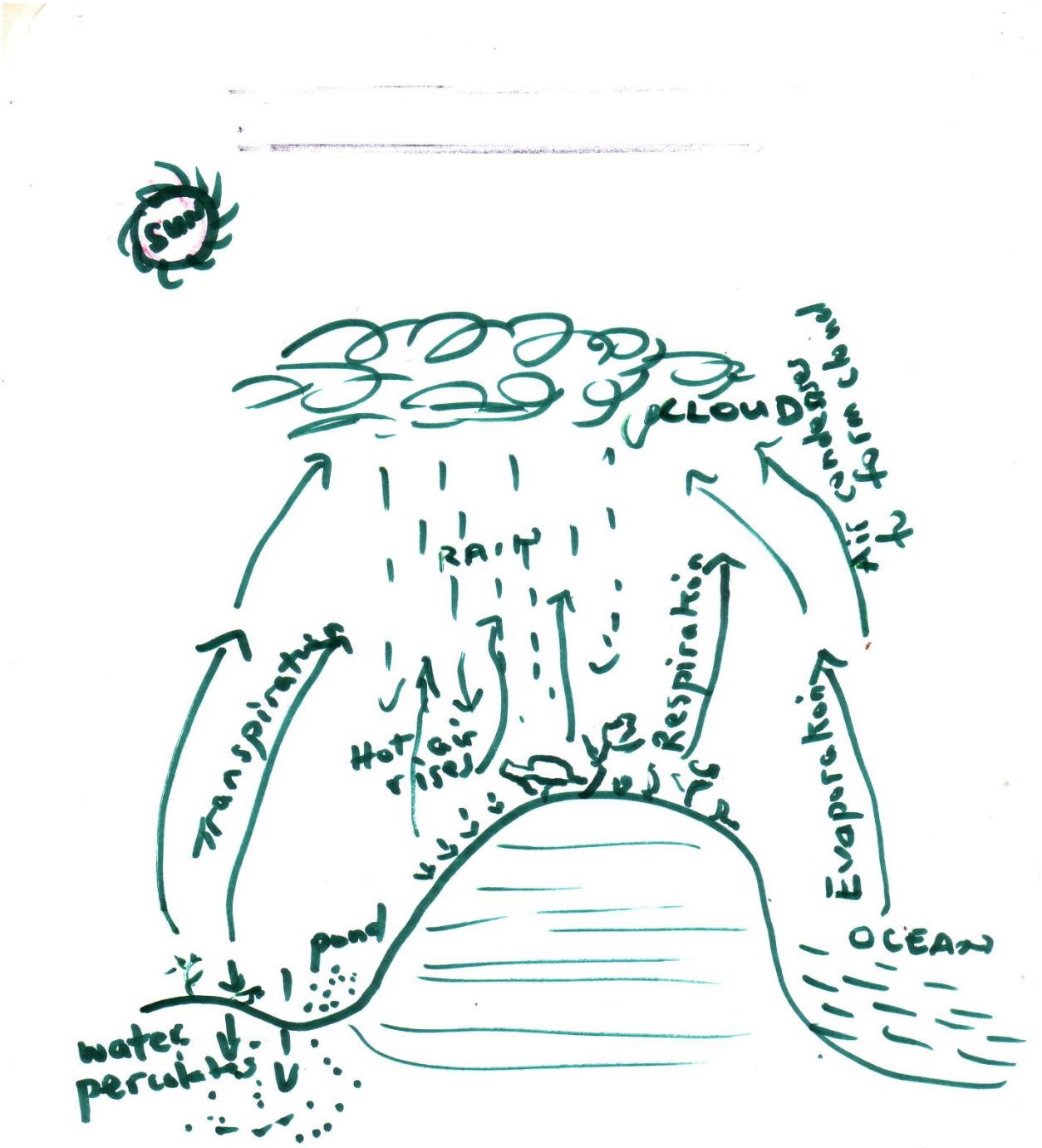


Diagram of Water Cycle for Conventional Lecture Method

APPENDIX III

NOTE OF LESSON ON PREVENTION OF STIS, HIV/AIDS

Appendix IA:FREEWRITING BRAINSTORMING STRATEGY

THEME: You and Environment

TOPIC: Prevention of STI'S, HIV/AIDS

CLASS: JSSI1

AVERAGE AGE OF STUDENT: 13 years

DURATION: 40 minutes

Problem Statement: How can I avoid getting HIV/AIDS?

PREVIOUS KNOWLEDGE:

- Types and modes of transmission of sexually transmitted diseases.
- Signs and symptoms of STI'S

LEARNING OUTCOMES:

The lesson will work towards a change in behaviour of students- learn to say no to sex, no to sexual harassment, not sharing objects and refusing to be circumcised, have tattoos or tribal marks.

BEHAVIOURAL OBJECTIVES:

- At the end of the lesson, students will be able to:
- Explain the meaning of HIV/AIDS
- State four ways by which people get HIV/AIDS
- Describe four types of human contact that do not spread HIV/AIDS
- Describe how HIV/AIDS can be prevented.

INSTRUCTIONAL MATERIALS:

- Chalk and chalkboard
- Charts and handouts
- Films, posters on HIV/AIDS
- TV, Video and Generator

Presentation:

STEP I: Re-arrange the students as may be necessary. Teach students on HIV/AIDS song that discourages people from contracting it. Take some dancing steps as they sing the song.

STEP II: Briefly review previous lesson by asking questions and engaging students in discussion.

STEP III: Teacher writes the topic of the day as problem statement

How can we prevent HIV/AIDS from our society?

STEP IV: Brainstorming session

- Divide class into two groups A and B. Share posters of ways of contracting
- HIV/AIDS among students in GROUP A and ways that would not spread it among GROUP B
- Instruct students not to engage in any discussion and not to disturb others.
- Teacher also should instructs students to write freely on what they see within five minutes.
- Teacher collects ideas from students after stipulated time.

STEP V: Teacher reads some ideas and engages students in discussion to clarify issues.

- Teacher organizes the ideas and write them on the black board for students to copy into their notebooks.

EVALUATION: Teacher evaluates students written responses after the lesson and verbally during discussion.

ASSIGNMENT:- Teacher tasks students to identify behaviours that can prevent contracting HIV/AIDS among youths.

APPENDIX IIIB

QUESTIONING BRAINSTORMING INSTRUCTIONAL STRATEGY

THEME: You and your Environment

TOPIC: Prevention of STI'S, HIV/AIDS

CLASS: JSS II

AVERAGE AGE OF STUDENTS: 13 years

DURATION: 40 minutes

TOPIC: How can I avoid getting STI'S, HIV/AIDS

Previous knowledge:

- Sexually transmitted infection
- Types and mode of transmission
- Signs and symptoms of sexually transmitted diseases.

LEARNING OUTCOMES:

The lesson will work towards a change in behavior of students- learn to say no to sex, no to sexual harassment, not to be circumcised, students will be able to:

- Explain what HIV/AIDS means
- State four ways by which people get HIV/AIDS
- Describe four types of human contact that do not spread HIV/AIDS
- Discuss how HIV/AIDS can be prevented

INSTRUCTIONAL MATERIALS:

- Chalk and Chalkboard
- Handouts

PRESENTATION:

STEP I: Start the lesson by asking students to sing a song:

- "The disease without cure.

- God will not let it affect us"/2ce
- While singing the song, students' interacts and direct the song to each other.

STEP II: Teacher writes the topic on the board as problem statement:

- What is HIV/AIDS?
- How can we prevent HIV/AIDS?

STEP III: Teacher gives out handouts containing questions to stimulate ideas on the problem and supply materials on which to put down the ideas generated.

STEP IV: Teacher explains guidelines to guide brainstorming.

STEP V: Brainstorming session

Students are given 10 minutes to put down their ideas on the questions on the handouts.

Teacher clarifies ideas to remove wrong conceptions and note the issues on the chalkboard such as:

- HIV is the causative organism called Human Immune Deficiency Virus.
- HIV is very dangerous because it destroys body's immune system,
- AIDS (Acquired immune deficiency syndrome develops when the body's defense system can no more fight disease as a result of HIV effect on the defense system.

There are four main ways of contracting HIV/AIDS

- Having unprotected sex with an infected person
- Sharing sharp object with infected person
- Blood transfusion from an infected person
- From infected mother to baby during pregnancy

Clarify issues that not all body interactions cause transmission of HIV/AIDS;

Therefore hugging, sleeping together, sharing of toilets does not cause HIV/AIDS.

Preventive measures are mainly the avoidance of methods of transmission

STEP VI: Outline major ideas systematically on the chalkboard for students to copy in their notebooks.

STEP VII: Evaluation

- Collect materials generated during lesson and mark after lesson
- Ask the question again to assess their response.

Assignment: Students should write on the effect of HIV/AIDS on the society.

QUESTIONS ON HIV/AIDS?

- Where did you first heard about HIV/AIDS?
- How do you hear about HIV/AIDS?
- How do people with HIV/AIDS look like?
- What is HIV?
- What is AIDS?
- How do you think those people got infected?
- How can we prevent HIV/AIDS in our society?
- Which of these interactions can cause HIV/AIDS) and which ones cannot (Tick the correct options)

  (A) Hugging (B) Mosquito bite (C) Unprotected sex

  (D) Multiple sex partners (E) Eating together (F) Sleeping together

  (G) Unscreened blood (H) Mother to child

APPENDIX IIIC

CONVENTIONAL LECTURE METHOD

THEME: You and Your Environment

Class: JSS IB

TOPIC: Preventive measures of STI'S, HIV/AIDS

PREVIOUS KNOWLEDGE:

- Types and modes of transmission of sexually transmitted diseases.
- Signs and symptoms of STI'S
- Learning outcomes: the lesson will work toward a change in behavior of student-learn to say no to sex, no to sexual harassment, not sharing sharp object and refusing to be circumcised, have tattoos, or tribal marks.

BEHAVIOURAL OBJECTIVES: At the end of the lesson, students will be able:

- Explain the meaning of HIV/AIDS
- State four ways by which people get HIV/AIDS
- Describe how HIV/AIDS can be prevented.

INSTRUCTIONAL MATERIALS:

- Chalk, chalkboard
- Posters, charts
- Film, TV, Generator

PRESENTATION:

STEP I: The teacher maintains orderliness and silence in the class.

STEP II: The teacher briefly reviews the previous lesson.

STEP III: Teacher writes the topic of the day as on the chalk board- preventive measures of HIV/AIDS.

STEP IV: Teacher displays posters on how to contract and how to contract HIV/AIDS. Teacher explains the mode of transmission. Teacher periodically asks questions to ensure that the students are alert.

STEP V: Teacher summarizes the lesson on the chalkboard and asks student to copy. If films materials are available, teacher also shows how the films explaining what could be seen of HIV/AIDS

STEP VI: The teacher may teach students song that will discourage their falling victims of HIV/AIDS.

STEP VII: Teacher goes round the class while the student write down the notes.

STEP VIII: Assignment - Write four ways of contracting HIV/AIDS.

APPENDIX IV A

STUDENT'S BASIC SCIENCE ACHIEVEMENT TEST (SBSAT)

Instruction: Answer all questions. shade only the correct option on the answer sheet.

1. The energy of position is ---------- (a) Mechanical (b) Potential (c) Solar (d) Nuclear
2. The structure of a plant that makes it green is called (a) Nucleus (b) Chloroplast (c) Cellulose (d) Cytoplasm
3. The ultimate source of energy on earth is the (a)Moon (b)Star (c)Sun (d)Green plants
4. Which of these is NOT a sign of STI in a man (a) Discharge from the vagina (b) Persistent fever (c) Discharge like pus from the penis (d)Pain and swelling of the testicles.Some examples of STIs include the following EXCEPT,(a) Gonorrhoea (b) Cholera (c) Syphilis (d) PID
5. What characteristic is demonstrated by a girl who dropped a pot because it was hot? (a) Reproduction (b) Irritability (c) Growth (d) Excretion.
6. Animals need to move about in search of their food because (a) They all have legs (b) They have teeth to kill their food (c)They cannot make food for themselves (d)They have eyes to see.
7. ---------- is the use of scientific discovery to help make man's work easier and to help him live better and enjoy his environment. (a) Automobile (b) Technology (c) Engineering (d) Scientific Literacy.
8. Which is the BEST method to prevent STIs (a) Abstinence (b) Regular (c) Sexual intercourse (d) Hugging
9. When glucose is oxidized in the body to release energy, the products are (a) Oxygen and Carbon (b) Energy and Carbon (iv) Oxide (c) Energy, Water and Carbon (d) Energy, Oxygen and Water.

10. Which of these statements is NOT true (a)The higher one rises into atmosphere, the less the oxygen present (b)Deep water has less amount of Oxygen (c)People who travel in aero planes need Oxygen masks (d)If we get little Oxygen, we can suffocate and die.

11. What chemical would you use to show that coca cola contains carbon (iv) oxide? (a) Slaked lime (b) Lime juice (c) Lime water (d) Caustic soda.

12. The special instrument to find accurately that a patient has high fever is (a) Measuring Cylinder (b) Thermometer (c) Rainguage (d) Anemometer.

13. Which of the following objects would floats in a water (a) Nails (b) Balloon (c) Plank board (d) Filled tin can.

14. When ice block was warmed gently, it occupied a larger space this is because the particles (a) Have moved closer together (b) Have gained energy and moved apart (c) Have changed their shape (d)Have gone into the air.

15. Tom put different types of soil into each of 13 flowerpots and put bean seed in each of them. He discovered that it grew best in the loam soil and less in the clay soil because (a) the clay lacked air nutrients (b) the clay was dark in color (c) the clay was dry and cracked (d) there were no earthworms in the clay.

16. Which of these chemical processes does not help keep constant the percentage of oxygen in the atmosphere? (a) transpiration (b) osmosis (c) photosynthesis (d)respiration

17. The color of my blouse is blue therefore my blouse has (a) absorbed blue light (b) deflected others rays of light and absorbed all the rest

18. Which of the following is NOT a component of ICT? (a) fax machine (b) internet (c)telephone (d) metallurgy

19. What voltage is needed to cause a current of 15 amperes to flow through a resistance of200ohms? (a)120 volts (b) 125 volts (c)150 volts (d) 125 amperes.

20. Which of the following is NOT a way of eradicating malaria parasite in he community? (a) mosquitoes should not be allowed to breed (b) there could be stagnant water in the house (c)areas around the house should e well drained (d)cut all bushes around the house.

21. How would you prevent electric shock from your electric iron? (a) Cover all wires with insulator (b) close all circuits (c) wet all clothes before pressing (d) put iron on the table.

22. Which of these liquids will not remove oil stain from your cloth? (a) kerosene (b) water (c) petrol (d) alcohol

23. Why do you need a fuse in electric current (a) to reduce amount of heat flowing (b) to allow enough heat to pass (c) to protect electric circuit from overflowing (d)to measure the amount of current flowing through the circuit.

24. A piece of coin put in a bowl of water appears raised from its normal position. This is due to (a) refraction of light (b)reflection of light (c)absorption of light (d)incision of light.

25. If my tire gets punctured, what appropriate machine would I use to lift the car? (a) stretcher (b) screw driver (c) jack (d) crane.

26. A man carried a 2kg of load through a distance of 1meter. How much work has he done for a mass of 1kg (Gravitational force is 10N) (a) 20 joules (b)2.o joules (c)10 joules (d) 1.5 joules

27. In an area of 200cm2, there were twenty ants, what is the population of the ants (a)1 ant 1cm2 (b)10 ants 1cm2 (c)20 ants 1cm2 (d)2 ants 1cm2

28. A girl that complain of prolonged diarrhea, fever for a long time and severe skin rashes may likely suffers from (a) syphilis (b)malaria (c)AIDS (d)diabetes.

29. Which of these is not a Risky Behavior (a) hugging (b) holding hands (c) talking (d) together sharing sharp objects like needle and blade.

APPENDIX IV B

STUDENT'S BASIC SCIENCE ACHIEVEMENT TEST (SBSAT)

Section A: Personal Data:

Name of Student:_____

Name of School:_____

Gender: Male ☐ Female ☐

Age Below 10 ☐11-15☐ 16-20☐

Class_____**Arm of class**_____

Section B: Respondent's Responses

Instruction: Please shade correctly the option that corresponds to your answer to the question.

=A= =B= =C= =D=

=A= =B= =C= =D=

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APPENDIX V

STUDENT'S ATTITUDE TO BASIC SCIENCE SCALE (SABSS)

Section A: Personal Data

Name of student:

Name of School:_____

Class:_____ **Arm of class**_____

Gender: Male ☐ Female ☐

Age: Below 10 ☐ 11-15 ☐ 16-20 ☐

Section B

Instruction: Please read the following statement carefully and tick the option that agree with your feeling

Key: S A = Strongly Agree A = Agree

D = Disagree SD = Strongly Disagree

S/N	Attitudinal Statements	SA	A	D	SD
1	I like Basic science very much				
2	Basic science is easy to understand				
3	Basic science involves a lot of cram work				
4	Equation in basic science is scaring				
5	Solving problem in basic science is interesting				
6	Basic science is fascinating				
7	Reading Basic science is a waste of time				
8	I am always happy in a Basic Science class				
9	Basic Science is a dull subject				
10	I will like to do basic science related course in future				

11	Basic Science is too difficult to cope with				
12	Basic science is easily forgotten				
13	Basic science should be made compulsory for student				
14	I will encourage my brother and my sister to offer basic science				
15	I do not derive joy from the study of basic science				
16	I have nothing gain in studying basic science				
17	I have a feeling that I can read and understand basic science				
18	I feel a definite positive reaction to basic science because it is enjoyable				
19	I am always uncomfortable in basic science				
20	Preparation for a test in basic put me under a lot of hardship.				

APPENDIX VI

STUDENT'S PERSONALITY TRAIT SCALE (SPTS)

Section A: Personal Data

Name of school:_____

Name of student:_____

Class:_____ **Arm of class**_____

Gender: Male ☐ Female ☐

Age: Below 10 ☐ 11-15 ☐ 16-20 ☐

Section B:

Instruction: Please indicate whether you AGREE or DISAGREE with the following statements about your personal characteristics by making a tick in the appropriate column.

S/N	Item statement	Agree	Disagree
1	Talking makes me comfortable		
2	I hate a quite environment		
3	I like actions and activities around me		
4	I am impatient with slow and complicated procedures		
5	I easily start conversations even with strangers		
6	I always hesitate to speak up ideas		
7	I like to work alone		
8	I am comfortable when not required to speak in class		
9	I need time to think before answering a question		
10	I am quite around strangers.		

APPENDIX VII

EVALUATION SHEET FOR EVALUATING TEACHER PERFORMANCE DURING TRAINING (ESATP)

Guidelines for evaluating facilitator training on brainstorming strategies

Name of Teacher: _____

School: _____

Sex: _____

	V. Good 5	Good 4	Average 3	Poor 2	V. Poor 1
Rate of student's arousal					
Introduction of the lesson					
Lesson preparation					
Teacher's Adequate use of time					
Teacher's disposition to new innovation					
Teacher's ability to control the class					
Ability to categorize ideas					
Ability to keep student focused					
Attainment level of desired objectives					
Adequacy of block-buster materials					