**UNIVERSITY OF EDUCATION, WINNEBA**

# USING ACTIVITY METHOD TO IMPROVE BASIC SCHOOL PUPILS' PERFORMANCE IN INTEGRATED SCIENCE

**AMPADU-DAADUAM, RUTH ASIAMAH**

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**(8150130006)**

**A THESIS IN THE DEPARTMENT OF SCIENCE EDUCATION, FACULTY OF SCIENCE EDUCATION, SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES, UNIVERSITY OF EDUCATION, WINNEBA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE MASTER OF PHILOSOPHY DEGREE IN SCIENCE EDUCATION**

**AUGUST, 2017**

# DECLARATION

## STUDENT'S DECLARATION

I, **AMPADU-DAADUAM, RUTH ASIAMAH,** hereby declare that this thesis, with the exception of quotations and references contained in published works which have all, to the best of my knowledge, been identified and acknowledged, is entirely my own original work, and that it has not been submitted, either in part or whole, for another degree elsewhere.

**SIGNATURE: ……………………………..**

**DATE: ………………………………………**

## SUPERVISOR'S DECLARATION

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

**NAME OF SUPERVISOR: DR. SAMLAFO B. VICTUS**

**SIGNATURE: ……………………………..**

**DATE: ………………………………………**

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I am also grateful to my father Rev. Kofi Asiamah Ampadu-Daaduam. Dad, your support is beyond my understanding. Father's day will be pleasurable if we have few of your calibers as fathers in this world.

# DEDICATION

I dedicate this work to God Almighty who granted me the strength for this work. It is also dedicated to my husband, Mr. Ofori Hanson, my father Rev. Asiamah Ampadu-Daaduam and my children; Princess, Sydnor and Manuel for their prayers, financial support, love and patients.

# TABLE OF CONTENTS

# LIST OF TABLES

**Tables** **Pages**

# LIST OF FIGURES

# LIST OF ABBREVIATIONS

| | | |
|---|---|---|
| **B.E.C.E** | - | Basic Education Certificate Examination |
| **MOE** | - | Ministry of Education |
| **MOESS** | - | Ministry of Education, Science and Sports |
| **NERDC** | - | National Education and Development Council |
| **OECD** | - | Organisation for Economic Co-operation and Development |
| **OSTP** | - | Office of Science and Technology Policy |
| **STM** | - | Science Technology and Mathematics. |
| **UNESCO** | - | The United Nations Educational, Scientific and Cultural Organization. |
| **WASSCE** | - | West African Senior School Certificate Examination |

# ABSTRACT

The purpose of this study was to use the practical activity method (hands-on) as the most effective instructional teaching approach or style to improve pupils' academic performance in the learning of mixtures and changes of state of matter for pupils of Effutu Municipal Assembly Primary School. The study used a case study design (action research) and non-probability and purposive sampling techniques in choosing the participants for this study who were Primary Five pupils of the Effutu Municipal Assembly Primary School to obtain data for the study. The sample size for the study was sixty-three (63). Test and observation schedules were the main research instruments used. The data obtained from the tests were analysed using Frequencies, percentages, means, standard deviations and related-samples wilcoxon Signed Rank test statistical tools to find out pupils' achievement level after the intervention (activity method). The results revealed that the pupils had very limited knowledge and conceptual understanding of mixtures and changes of state of matter because the mean for all the pre-intervention test were very small as compared to the mean for the post-intervention test. The results also showed that the performance of the pupils improved significantly after the activity method of teaching and learning of science interventions for mixtures and change of state of matter was carried out in the school. The results further indicated that, there was a statistically significant difference of 0.00 between pre-intervention and post- intervention performance of pupils' preconceptions of mixtures. There was also a statistically significant difference of 0.00, between pre-intervention and post- intervention performance of the pupils' conceptual understanding of mixtures and change of state of matter. It was recommended that the study be replicated using the activity method of teaching as instructional strategy to teach other concepts in integrated science.

# CHAPTER ONE

# INTRODUCTION

## 1.0 Overview

The chapter is structured under the following headings; Background to the study, statement of the problem, purpose of the study, research objectives, research questions, hypothesis, significance of the study, delimitations, limitations, operational definitions and abbreviations.

## 1.1 Background to the Study

Brown (1997) articulated that integrated science is a very difficult subject. For a country to develop, its sciences and applications must be taught very well to its citizens (especially those at the basic school level) who are now building upon their knowledge in science. According to Shadreck and Mambanda (2012) and Anamuah-Mensah (2004), a country's development rested on science and its application in the world of work and industry and competent workers and citizenry need a sound understanding of science and mathematics.

But science education is without problems especially at the basic school level. Babalola and Samuel (2011) stated that, research literature from countries around the globe provides evidence of much commonality in the types of problems and issues confronting science education, especially at the primary and secondary levels. The study further revealed that issues such as poor performance in science, low enrollment in science courses at the upper secondary and tertiary levels, as well as poor interest and attitudes to science have plagued the education systems of many countries for decades. Students are either still finding science too difficult, or, for various reasons, their interests are being drawn away. According to WAEC Reports (1999), the poor performance of students in science subjects has assumed a dangerous dimension and in the light of this, science educators need to seek suitable ways of tackling the current mass failure if they are to halt the drifts of students to arts and social science subjects

Integrate science is a very wide and broad subject because it is a combination of the many branches of science, thus chemistry, biology, physics, geology, agriculture science etc. Some few concepts under these branches in the primary school syllabus to be precise, primary five are; mixtures and change of state of matter, the human body system and forms of energy. The pupils find it very difficult linking all these as one subject. The concepts of mixtures and change of state of matter must be of great concern since the central point of all sciences is chemistry. If the pupils understand mixtures and change of state of matter very well, they can easily link it up with the other concepts and see integrated science as one whole.

There are several factors affecting the performance of pupils during the teaching and learning of selected integrated science concepts such as mixtures and change of state of matter. Some of the factors that hinder performance of pupils in mixtures and change of state of matter in integrated science are discussed below;

Teaching methods need to be improved and appropriate teaching strategies employed as the teaching-learning situation may demand. Teaching methods such as inquiry, project, lecture-demonstration, problem-solving, field trips, cooperative or group learning, excursion, remedial, laboratory and guided discussion and the use of audio-visual materials have been recommended for the teaching of science in schools (Webb, 1982; Rogus, 1985; Adedoyin, 1990; Ajewole, 1991).

Apart from the teaching methods that may hinder the performance of pupils in mixtures and change of state of matter, teacher qualification is also a matter of great concern. Agyeman (1993) reported that a teacher who does not have both the academic and professional teacher qualifications would undoubtedly have a negative influence on the teaching and learning of his or her subject. Hence if a teacher is academically and professionally qualified, it will have a positive influence on the teaching and learning-process.

The conditions under which teachers work can also adversely affect the performance of the pupils. According to Agyeman (1993), teachers who are academically and professionally qualified but work under unfavourable conditions of service would be less dedicated to their work and thus be less productive than teachers who are unqualified but work under favourable conditions of service. Poor supervision of teachers can also have a negative effect on the performance of pupils in the teaching and learning process. Neagleg and Evans (1970) were of the view that effective supervision of instruction can improve the quality of teaching and learning in the classroom.

Motivation of teachers can also affect the performance of pupils positively or negatively. Dornyei (2001) stated that teacher efficacy affects students directly as there is a strong correlation between teacher efficacy and students' performance hence a desired outcome by the students can occur with the help of the teacher. Marques (2010) also stated that motivation, satisfaction and performance are interdependent. According to Hanson (2011), motivation directs our energies and behaviours towards the attainment of the school's specified goals. The process of motivation refers to individual influences with regard to the priorities, attitudes and aspects of life style that we may seek to fulfil in our work (Moully 2008). When it comes to motivation of teachers to bring about an improved performance in pupils at the basic school level, the head teachers also have roles to play. McGrown (2005), reminded us that the job of the school head as organizational manager, is to inspire, encourage and impel those working under him / her to do whatever is necessary to achieve the school's goals through the process of motivation.

A highly motivated person puts in the maximum effort in his or her job producing a positive outcome. A low motivated person puts in little effort producing negative results.

There are a number of factors that affect pupils' learning. Some are inherited while others are obtained from the environment. Akinboye *et al* (1985) noted that the factors that affect learning can be broadly classified into the following categories: hereditary factors, personal factors, physiological factors, background and environmental factors, health and nutritional factors, situational factors, study habits and examination factors, instructional factors, school management factors, motivational factors and miscellaneous factors. Akinboye (1986), further stated that Educational psychology is conceptualized as an applied psychology in which psychological principles are used to bring about positive changes in the learner, the teacher, teaching strategies, the learning process, the learning situation, curriculum and the assessment of learning.

Aside the teaching style, pedagogies or method used by the teacher in teaching integrated science concepts –mixtures and change of state of matter is very important. Taking the pupils through series of activities is one of the best methods of teaching science. According to Petty (2001) activity methods of teaching are methods of teaching in which the teacher involves the learners in a series of task. Mensah (1992), also defined activity–based method as a teaching strategy that attempts to assist pupils to discover their own knowledge through an activity. Reisman & Payne (1987), further stated that activity–based method is more of a child-centred approach, pupils may learn better and faster when they are taught through activities. The activity method is used to teach science in which the pupil is placed at the centre of the learning process and made to manipulate materials and experience things for him or herself (Mensah, 1992).

The West African Examination Council Chief Examiner' report (2012) on B.E.C.E revealed that the standard of performance in integrated science was reported to be below that of the previous years. In integrated science, the candidates were unable to apply scientific knowledge to physical phenomenon. Ghana News Agency, Education (2012)-The Effutu Municipal Education directorate has expressed concern about the poor results of basic schools in the area despite the fact that 87% of their teachers have first and second degrees in education. Ghana Statistical Service- Population and Housing Census (2010, 2014) revealed that in 2010, 2011, 2012 and 2013, 47.43%, 37.05%, 47.29%, and 55.56% percent of the candidates who sat for B.E.C.E. failed. This is very alarming and the country must take a second look at this issue very critically.

A search of the available literature revealed that no study was focused on the teaching and learning on selected integrated science concepts in basic schools in the research area. Aside, the researcher's personal experience with some seasoned science educationalist indicated that there were gaps between the expected performance of pupils in integrated science at the basic schools and their actual output in their final examination. The above mismatch occasioned this study.

## 1.2 Statement of the Problem

The 2016 B.E.C.E results analysis of Effutu Municipal Education Directorate reveals that 51.3% of candidates passed in Integrated Science and 48.7% failed in integrated science. This Meant 621 candidates failed in integrated science out of 1275 candidates presented. This is just a little over an average performance. A detailed analysis of results in the same year also showed that not even one candidate got aggregate one in integrate science in some public schools in the municipality. The poor performance of JHS pupils at the BECE is a carry-over from their poor performance at the primary school level.

A critical look at the assessment (2010-2017), of the Effutu Municipal Primary School (primary 1-6) over the years, revealed a very poor performance in integrated science. The class five pupils recorded very low marks in most of the integrated science concept taught. The marks from the terminal exams were nothing to write home about. The pupils could not answer most of the questions. The answers provided by the pupils showed clearly that they did not understand the concepts taught.

## 1.3 Purpose of the Study

The purpose of this study was to use activity method (hands-on) to improve pupils' academic performance in the teaching and learning of mixtures and change of state of matter among pupils of Effutu Municipal Assembly Primary School.

## 1.4 Research Objectives

The study sought to: know

1. The pupils' preconceptions on mixtures.
2. The pupils' preconception on change of state of matter
3. The impact of activity method on the pupils' conceptual understanding of

mixtures and changes of state of matter

## 1.5 Research Questions

The following research questions were addressed:

1. What are the pupils' preconceptions of mixtures?
2. What are the pupils' preconceptions on change of state of matter?
3. What are the impact of activity method in teaching on pupils' conceptual understanding of mixtures and change of state of matter?

## 1.6 Null Hypothesis

1. There is no significant difference between pre-test and post- test performance of pupils' preconceptions of mixtures.
2. There is no significant difference between pupils' science test scores before and after participation in the activities to improve pupils' performance in mixtures and change of state of matter.

## 1.7 Significance of the Study

The findings from this study such as pupils' preconceptions of mixtures and change of state of matter could help heads of schools to create an enabling environment in their schools by encouraging teachers to find out the pupils preconcepts on topics to be taught before going ahead to introduce new concepts. This study sought to help primary school teachers adopt some effective teaching strategies and activities in helping to improve the understanding of pupils' in science concepts. The data obtained can also be used to design interventions to improve primary science teaching and learning.

The study will help Policy makers, educationalists, curriculum developers and curriculum implementers to adopt the teaching strategies to help improve the falling standards of education in the country.

## 1.8 Delimitations of the Study

The study was restricted to basic five of Effutu Municipal Assembly Primary School. It did not cover all integrated science concepts in primary five.

## 1.9 Limitations of the study

Co-curriculum activities disrupted activities on several occasions during most of the intervention sections, hence the result might be affected

## 1.10 Operational Definition of Terms

Pre-intervention test – Refers to a test that will be given to pupils before taking them through the teaching methods (intervention).

Post- intervention test - Refers to a test that was given to pupils after they have been taken through the teaching methods (intervention).

# CHAPTER TWO

# LITERATURE REVIEW

## 2.0 Overview

This chapter deals with theoretical framework of the study, empirical study, teaching science through field trips, factors affecting learning in schools, factors influencing gender performance in science, concept teaching in science, the role of pupil's prior knowledge in teaching and learning, a naive view of change of states of matter and other related literature about the study.

## 2.1 Theoretical Framework of the Study

The theoretical framework of the study is focused on cognitivist and constructivist theory of learning but it would be based more on constructivist theory. Both cognitivists and constructivists view the learner as being actively involved in the learning process, yet the constructivists look at the learner as more than just an active processor of information; the learner elaborates upon and interprets the given information (Duffy & Jonassen, 1991). Cognitivism involves examining learning, memory, problem solving skills, and intelligence. Cognitive theorists would like to understand how problem solving brings about changes during childhood, how cultural differences affect the way we view our own academic achievements, language development, and much more. In this approach, the individual is consciously engaged in the construction of a product (Li, Cheng, & Liu, 2013). The utilization of constructionism in educational settings has been shown to promote higher-order thinking skills such as problem-solving and critical thinking (Li et al., 2013). It is seen to create an enabling environment where there are a lot of tools to manipulate and develop and understanding. The teacher or the instructor can pose questions to assist students to enhance their thoughts and know where they could be wrong. Constructivist learning theory says that all knowledge is constructed from a base of prior knowledge. That is, learning is based on what the child knows already and would build on previous knowledge to obtain new knowledge. Children are not a blank slate and knowledge cannot be imparted without the child making sense of it according to his or her current conceptions. They have something in their brains and can build on that to acquire new one. Consequently, children acquire more knowledge or learn best when they manipulate objects and gain experience from them.

Piaget's role in the constructivist teaching suggested that we learn by expanding our knowledge by experiences which are generated through play from infancy to adulthood which are necessary for learning. At the heart of constructivist philosophy, is the belief that knowledge is not given but gained through real experiences that have purpose and meaning to the learner, and the exchange of perspectives about the experience with others (Piaget & Inhelder, 1969; Vygotsky,1978).

Constructivist philosophy has a long history of application in educational programmes for young children, but is used less frequently in adult learning environments. The philosophers also argued that students' especially elementary school-aged children are naturally curious about the world, and giving them the tools to explore it in a guided manner would serve to give them a stronger understanding of it.

The goal of instruction is to map the structure of the world onto the learner (Jonassen, 1991b). This means that the learners would actively process the incoming information and assimilate them to select the relevant data. This relevant information is organized to form new concepts and then to be integrated to the existing knowledge.

Constructivism is a theory that equates learning with creating meaning from experience (Bednar et al., 1991). Even though constructivism is considered to be a branch of cognitivism (both conceive of learning as a mental activity), it distinguishes itself from traditional cognitive theories in a number of ways. Most cognitive psychologists think of the mind as a reference tool to the real world; constructivists believe that the mind filters input from the world to produce its own unique reality (Jonassen, 1991a). Constructivists do not deny the existence of the real world but contend that what we know of the world stems from our own interpretations of our experiences. Since there are many possible meanings to glean from any experience, we cannot achieve a predetermined, "correct" meaning. Learners do not transfer knowledge from the external world into their memories; rather they build personal interpretations of the world based on individual experiences and interactions. Thus, the internal representation of knowledge is constantly open to change; there is not an objective reality that learners strive to know. Knowledge emerges in contexts within which it is relevant. Therefore, in order to understand the learning which has taken place within an individual, the actual experience must be examined (Bednar et al., 1991). Brown, Collins, and Duguid (1989) suggested that situations actually co-produce knowledge (along with cognition) through activity.

Every action is viewed as "an interpretation of the current situation based on an entire history of previous interactions" (Clancey, 1986). Understanding is developed through continued, situated use and does not crystallize into a categorical definition" that can be called up from memory (Brown et al., 1989). Constructivists emphasize the flexible use of preexisting knowledge rather than the recall of prepackaged schemas (Spiro, Feltovich, Jacobson, & Coulson, 1991). Mental representations developed through task-engagement are likely to increase the efficiency with which subsequent tasks are performed to the extent that parts of the environment remain the same: “Recurring features of the environment may thus afford recurring sequences of actions” (Brown et al., p. 37). To be successful, meaningful, and lasting, learning must include all three of these crucial factors: activity (practice), concept (knowledge), and culture (context) (Brown et al., 1989). According to Windschitl Mark (`1999), constructivist is based on the assertion that learners actively create, Interpret, and reorganize knowledge in individual ways. These fluid intellectual transformation, he maintained, occur when students reconcile formal instructional experiences with their existing knowledge, with cultural and social context in which ideas occur, and with a host of other influences that serve to mediate understanding.

An essential concept in the constructivist view is that learning always takes place in a context and that the context forms an inexorable link with the knowledge embedded in it (Bednar et al., 1991). Therefore, the aim of instruction is to exactly show tasks, not to define the structure of learning necessary to accomplish a task. If learning is decontextualized, there is little hope for transfer to occur. The constructivist view is to show students how to construct knowledge, to promote collaboration with others to show the multiple perspectives that can be brought to bear on a particular problem, and to arrive at self-chosen positions to which they can commit themselves, while realizing the basis of other views with which they may disagree’ (Cunningham, 1991). Even though the emphasis is on learner construction, the instructional designer/teacher’s role is still critical (Reigeluth, 1989).

As one moves along the behaviorist-cognitivist-constructivist continuum, the focus of instruction shifts from teaching to learning, from the passive transfer of facts and routines to the active application of ideas to problems.

Teaching strategies using social constructivism as a basis of reference connect well with teaching in a situation that could be personally meaningful to pupils. The pupils are allowed to do hands –on activities so as to gain experience and to acquire knowledge from it. These also involve negotiating understanding with students through class discussion in small as well as large groups of students (Dougiamas, 1998). The study is underpinned by cognitive theory of learning because the entire being of the learner is involved in construction of knowledge from the perspective of social constructivism discussed above. In other words, learning involves all the three domains: cognitive, psychomotor and affective domain and all the three are equally important in the construction of knowledge.

## 2.2 Empirical Studies

In teaching integrated science at the basic school level, one approach that dominates is the traditional approach to science teaching. Beck (2009) explained that traditional approach to science teaching is an approach where students sat quietly at their places and listened to one students after another recite his or her lesson until each had been called upon. The study further explained that teachers' primary activity was direct instructions to students, assigning and listening to recitations and a test or oral examinations while students' role was to listen, observe and recite. Martins (1994) and Knowles (1980), confirmed that most integrated science teachers in Nigeria today employ the Traditional Method of teaching. Balogun (1995) stated that teachers and students generally had a favorable attitude towards integrated science, although teachers agreed that pupils should be actively involved in the teaching and learning process but it did not reflect in their teaching. The author continued to explain that teachers used expository, dictation of notes and talking in their science lessons. A number of authors supported Balogun's view. Hagertty (2000), and Chukwuneke

(2009) stated that teachers continued to teach science as a body of abstract knowledge to the detriment of active learning.

A number of studies carried out using activity- based instructional approaches came out clearly that students learned and performed better when they were actively involved in their learning process (Inyang, 1988; Usman 2000). A study by Shah and Rahat (2014), reported that performance of experimental group was better than the performance of the controlled group when activity based teaching was used on the students. The study further stated that there was significant difference between the performance of the experimental group as compared to the control group with reference to knowledge, comprehension, and application skills. Overall, the findings of the study showed that the activity based teaching was much effective than the lecture method teaching of science at elementary level. Fifteen years of study by Bredderman (1982), reported that the students in Activity-Based programme performed 20 percentile units higher than the comparison groups. The students in these programmes scored higher than the control groups in the following measures (ranked from largest to smallest differences) perception, science content, creativity, attitude, and mathematics.

The activity-based method of teaching could improve students' creativity in problem-solving, promote students' independence and help low ability students to overcome initial handicaps (Shymansky and Penick 1981). This meant that students who were even below average could improve tremendously when they are given the chance to manipulate items during the teaching and learning process. Caprico (1994), was also of the view that better examination grades were obtained by students taught using constructivist methodology. Constructivists emphasize the flexible use of preexisting knowledge rather than the recall of prepackaged schemas (Spiro, Feltovich, Jacobson, and Coulson, 1991). Mental representations developed through task-engagement are likely to increase the efficiency with which subsequent tasks are performed to the extent that, parts of the environment remain the same: "Recurring features of the environment may thus afford recurring sequences of actions" (Brown et al., 1989). The researchers further explained that to be successful, meaningful, and lasting, learning must include all three of these crucial factors: activity (practice), concept (knowledge), and culture (context). According to Windschitl Mark (`1999), constructivist is based on the assertion that learners actively create, Interpret, and reorganize knowledge in individual ways. An essential concept in the constructivist view is that learning always takes place in a context and that the context forms an inexorable link with the knowledge embedded in it (Bednar et al., 1991). Therefore, the aim of instruction is to exactly show tasks, not to define the structure of learning necessary to accomplish a task. The constructivist way of learning is also Activity-based.

Saigo (1999), and White (1999), concluded that "the constructivist model has been found to slightly influence students' achievement in a positive way." The constructivist model is capable of getting students more involved in learning. Skamp (2004), also suggested that the mind-on and hands-on method which actively involves the students is what Constructivist emphasized in it teaching approach hence knowledge gained last longer in their memory, since human beings are not passive recipients of information. Cheek (1992), also stated that learners actively take knowledge, connect it to previously assimilated knowledge and make it theirs by constructing their own interpretation.

However, Dogru and Kalender (2007), made a comparison between science classrooms using traditional teacher-centered approach and student-centered approach (constructivist methods).

The researchers tested the students' right after both approaches were used to teach. The researchers did not find any significant difference between the performance of students who were taught using the teacher centered and the traditional centered approaches (constructivist methods). But a follow-up assignment after 15 days later showed that students who were taught through constructivist methods showed better retention of knowledge than those who learned through traditional methods. Mayer (2004) and Kirschnes, Swellers, and Clark, (2006) have argued that little empirical evidence exist to support this statement given to novice learners. Swellers (1988), argue that novices do not possess the underlying mental models or "schemas" necessary for learning by doing" (Kirschner 2006). This means that beginners in a study cannot learn on their own by doing, hence learning by doing does not affect all levels of the educational system. Toplis (1998), Watson, Prieto, and Dillon (1995), reported that the use of practical work had only a marginal impact on 9th-graders' understanding of combustion and 8th-graders' understanding of acids and alkalis respectively. Similar, Bucknor and Soyibo (2001), recorded no significant differences in the knowledge of acids and bases of Jamaican 10th-graders taught using the lecture method, teacher demonstrations and practical work and those who were taught with the lecture and teacher demonstration methods. Remarkably, Mulopo and Fowler's (1987), came out with findings that suggested that Zambian 11th-graders taught chemistry with the lecture method, significantly outperformed their counterparts taught using the discovery approach or the activity-based method. This contradicted the findings of many studies (Walford Palmer, 2004; Thompson & Soyibo, 2002;

Ugwu & Soyibo, 2004; Archibong, 1997; Esiobu & Soyibo, 1995; Storhr-Hunt, 1996). Several studies have demonstrated that students taught science using practical work displayed better attitudes to science and had superior science achievement than those taught science using the lecture method or other teaching methods (Archibong, 1997; Stohr- Hunt, 1996; Thompson & Soyibo, 2002; Ugwu & Soyibo, 2004).

## 2.3 Teaching Science through Field Trips

According to Krepel and Duvall (1981) a field trip was 'a trip arranged by the school and undertaken for educational purposes, in which the students go to places where the materials of instruction may be observed and studied directly in their functional setting: for example, factories, a library, a museum, a polluted area, a university, a zoo, a radio station, a hydroelectric power station, a trip to a factory, a city waterworks, etc'.

Field trips can be considered as one of the three avenues through which science can be taught - through formal classroom teaching, practical work and field trips. Field trips expand children's learning through active hands-on experience with the rich resources of the local community. Field trips increase student knowledge and understanding of a subject and add realism to the topic of study. Field trips are recognized as important moments in learning; a shared social experience that provides the opportunity for students to encounter and explore novel things in an authentic setting. Importance of field trips is supported by professional organizations such as the National Science Teachers Association (NSTA 1999) which asserts that field trips can "deepen and enhance" classroom study and the National Research Council (1996), who asserts a quality science curriculum is one that extends beyond the walls of the classroom.

A number of authors use school excursion, ‘instructional trip, and school journey as synonyms for field trips. The term 'field work' stresses on some of the formal exercises done outside of the classroom, more often than not in biology and geology at senior high school and tertiary levels.

Quantitative studies of the attitudes of teachers towards field trips were undertaken by Falk and Balling (1979), Fido and Gayford (1982) and Muse, Chiarelott and Davidman (1982). The following are some benefits derived from field trips from the research undertaken by the researchers above; Hands-on, real world experiences, upgrading of the socialization between students would impinge on the classroom, and development of rapport between teachers and students, allowing teachers to utilize other learning strategies such as cooperative learning, quality of education, positive attitudes to science and motivation towards the subject.

Studies have revealed the use of field trips as a way of teaching science, has brought a major attainment of learning outcome in a variety of venues. There are also several studies to supports the affective changes in students caused by field trips. It is therefore, not out of place for some researchers, in view of the above, to suggest that field trips should be integrated into the teaching programme in the school (Griffin, 1996; Griffin & Symington, 1997; Price & Hein, 1991; Rennie & McClafferty, 1995).

**2.4 Factors Affecting Learning in Schools**

The performance of pupils in schools depends on several factors. Some are socio-economic, socio-cultural, psychological, environmental, hereditary, sex, race, gender etc. Walters & Soyibo (1998), stated that student performance is very much dependent on SEB (socio economic back ground) as per their statement, ‘high school students’ level of performance is with statistically significant differences, linked to their gender, grade level, school location, school type, student type and socio-economic background (SEB)'

### 2.4.1 The Effect of Socio- Economic Factors on Academic Performance

Research conducted by Abagi and Sheila (1994) on household based factors affecting participation and performance established that economic problems caused more school dropouts amongst girls than boys. It was detected that parents preferred to educate boys than girls during times of economic difficulties. Cooksey (1981), in the Journal of Comparative Education Review said good home material conditions were defined by the presence of running water, electricity, an interior toilet, a refrigerator and some form of cookers while poor home conditions were defined by the absence of all except one of the facilities. According to this study those living in good home conditions had pass rates over twice that of other children. Supporting the "good home" theory,

Pallas, Natriello and McDill (1989), linked between students' achievements, economic circumstances and the risk of becoming a drop-out that proved to be positive. Meaning the performance of pupils can be linked to the economic circumstances of the pupils. A child from a more affluent home is more likely to go through the educational ladder to the end than a child from a poor home. The later can easily become a drop-out. Age, qualification distance from learning place etc. can also have positive or negative influence on the performance of pupils.

Well educated parents will make sure that their children did their homework. Some parents even go to the school to enquire from teachers if their wards are not given homework. The parents understand the link between doing homework and school performance. Regardless of intelligence, students who spent more time on assignments and homework and other very important school activities improved their grades (Engin-Demir 2009). This gives an implication that if pupils do not do their homework, they will perform poorly academically. Homework is associated with academic performance, meaning it bores a positive relationship with learning outcomes when it is relevant to learning objectives. Etsey (2005) found homework to be a correlate of academic performance. The study further stated that "homework bore a positive relationship with learning outcomes when it is relevant to learning objectives, assigned regularly in reasonable amounts, well explained, motivational and collected and `reviewed during class time and used as an occasion for feedback to students" (p. 3). According to (Harbison & Hanushek, 1992; Alomar, 2006), homework is in reality an interaction between school and the home, and an essential ingredient of the educational process when measuring academic achievement.

According to Onyango (1983), poverty is one major cause of schools‟ poor performance in the Kenyan society. The study stated that most poor families in Kenya have large family sizes consisting of about six to ten children, were unemployed parents who were usually peasant farmers with small pieces of land. Such parents must work extremely hard to meet the basic needs of the family. The total number of siblings that a pupil has is assumed to have an influence on his/her academic achievement. If the family size is small, the pupils get more attention than if they are found in a larger family. Children from larger families have been found to have less favourable home environments and lower levels of verbal facility (Parcel & Menagham, 1994) as well as highest rates of behavioural problems and lower levels of education achievement (Downey, 1995). Most at times pupils from such families are found on the streets after school to look for fees. The pupils at the long rank will not perform well since they do not have time to be with their books and their major concern is to look for food, shelter, fuel etc.

### 2.4.2 The Effect of Teacher Factors on Academic Performance

The academic performance of pupils cannot be completed without considering the teacher side factors in schools. Some of the teacher side factors are attendance, motivation, teaching methods used by the teacher, teacher absenteeism etc. Teacher absenteeism is likely to contribute to poor academic performance. The prevailing evidence is that teacher absenteeism at primary school level in Ghana appears to have worsened in the last fifteen years (World Bank, 2004). Dunneand Leach (2005), talk about the low levels of professionalism in schools (especially low performing ones), with teachers having high rates of lateness, absenteeism and sometime refusing to teach classes. When teachers are well motivated, they teach very well but when they are less motivated, they teach poorly and this affect the performance of the pupils academically. Lockheed and Verspoor (1991) asserted that lack of motivation and professional commitment on the part of teachers produce poor attendance and unprofessional attitudes towards pupils which in turn affect the performance of students academically. Ofoegbu (2004), also stated that poor academic performance of students to poor teachers‟ performance in terms of accomplishing the teaching task, negative attitudes to work and poor teaching habits which have been attributed to poor motivation.

A teacher must be knowledgeable in his or her area of studies. He must have an idea about the books, teaching learning materials etc. that he will use in delivering knowledge to the pupils. A teacher's knowledge of the subject matter coupled with textbooks, instructional time and other learning materials have great influence on learning at the basic school level (Lockheed & Verspoor, 1991). Before a teacher can teach, the person must have a certificate in his or her field of study and this is significantly and positively associated with subject outcomes. Darling-Hammond (2000), found that teacher quality characteristics such as certification status and degrees in subject to be taught are very significant and positively correlated with subject outcomes in science and mathematics. Agyemang (1993), reported that "a teacher who does not have both the academic and the professional teacher qualification would undoubtedly have a negative influence on the teaching and learning of his/her subject" (p. 2).

Well experienced science teachers know the in and out of some difficult topics in science and can teach it with ease. Bilesanmi (1999) and Okoruwa (1999), found that teachers" teaching experience had significant effect on students" achievement in science.

To be able to bring about effective classroom teaching, the teacher should be able to employ all the necessary techniques needed in teaching in order to improve the performance of his or her pupils. Lockheed & Verspoor (1991), were of the view that effective teaching embraces a variety of different aspects of teaching such as subject mastery, effective communication, lesson preparation and presentation, pacing the class to the students" level and taking into account individual differences, allowing students to practice and applying what they have learned, letting students know what is expected of them, and monitoring and evaluating performance so that students learn from their mistakes.

### Home-related factors

Home-related factors also have a very great impact on pupil's performance. Some of the home -related factors are socio-economic status (education, occupation and income), the number of people in the family, the house chores done by the child, family structure, parental involvement and interest in a child's education and many more are all factors which affect performance of pupils in school. According to Christenson and Gorney (1992), family and environmental factors were found to affect students" achievement. The factors are parents" expectation and attribution, structure and learning, home environment, discipline, and parental involvement. The involvement of parents in children's education is a very great factor towards academic achievement. If the pupil is found in a home with the right environment and less household chores, he or she can get ample time to do his or her homework and learn as well.

## 2.5 Factors Influencing Gender Performance in Science

According to Mills, Ablard, and Stump (1993), science is important because the study of the subject is associated with more academic and or career opportunities. With the onset of technological advancement, it is very important that every human resource is harness to its fullness. For this reason, both sexes must perform well in the subject. This is however far from the truth. Boys are seen to be doing very well in science than their female counterpart. A study by Hedges and Newell (1995), showed male students outperformed female students in science, but in reading and writing female students did much better. Present-day events are fast changing the role women play in today's fast moving world. Their office is no longer the kitchen. They don't stay in the house to cook and raise children alone, but are the bread winners for their families. But women have huge influence on their children, husbands, their homes etc.

and so the role of women in national development cannot be miscalculated. When women are given the needed support, they can leave up to expectations. For this reason, women in today's world must develop the needed knowledge, consciousness and skills in science to be able to perform the expected role and live up to this challenge.

According to Dick and Rallis (1991), more girls than boys in secondary school seemed to have unfavourable attitudes towards science. The study also stated that this unfavouable attitude of girls towards science explained the gender differences in science achievement. It is however devastating that many female students have misleading impressions about science and hate science that much.

Socio- cultural variables also played a decisive role in gender difference when it comes to the study of science. Fox, Tobin and Brody (1985), suggested that socio-cultural variables are responsible for gender related differences in science achievements. UNESCO (2009), advocated against discrimination of women and girls in governance, skills development and education. The discrimination is due to ethnicity, restrictive traditional roles for women and endemic poverty. The same conference reported that Girls from marginalized groups are often sexually harassed due to neglect by the government. Tarayia (2004), stated that despite the progress that has been made to rectify gender disparities in Sub-Saharan Africa, cultural practices remain barriers to girls' access to quality education in the region. Most girls in their own homes act like servants, running errands here and there, taking care of the younger ones, fetching water and firewood, cooking etc. World Bank, (2004) and UNESCO (2004), stated that most girls from poor families spend substantial amount of time running households such as siblings, fetching water, collecting firewood and some cases cooking at home. These make girls waist their productive time while boys have all the time to learn.

Juma *et al* (2012) and Jones *et al* (2011), were of the view that parents' education and family interaction patterns during childhood were more linked to the child's developing academic success and achievement-oriented attitudes.

Aside the above factors, parents' education, low self-confidence of girls, the way science is taught or presented in the classroom etc. also have roles to play in the performance of both boys and girls in science.

In order to improve the performance of both sexes, all the above issues must be addressed so that both boys and girls do well in science.

**2.6 The Concept of Teaching Science**

A concept is an abstract idea representing the fundamental characteristics of what it represents. Concept arises as abstraction or generalizations from experience or the result of a transformation of existing ideas. Concept is also best defined as the fundamental units of thinking that underlie the intelligence and communication of human kind. Concepts are thought to be the essential constituent of thought and belief, and the essential units of thought and knowledge. Concepts are treated in many if not most disciplines both explicitly such as in philosophy, cognitive science, inductive data processing, analysis, inductive learning and many more.

Students form concepts in two ways - according to its defining properties (classical model) and according to the typical characteristics of its members (prototype model). The classical model clearly defines a plant as a living organism that has root, stem and leaves. The prototype model however deals with concept according to the broad characters of its members. The prototype model is useful in the events that all the members share the same characteristics. For instance, it's difficult to imagine whales and bats as mammals because most mammals walk on land. However, all of them have mammary glands, don't lay eggs, and have fur.

In concept formation, there are two basic issues known as aggregation and characterization. Aggregation aims at the identification of a group of objects so that they form the extension of a concept. Characterization attempts to describe the derived set of objects in order to obtain the intention of the concept.

For aggregation, one considers two main processes called differentiation and integration. Differentiation enables the students to grasp the differences between objects, so that they can separate one or more objects from other objects. Integration is the process of putting together elements into an inseparable whole. As the final step in concept formation, characterization provides a definition of a concept.

How can the science teacher promote conceptual change in students? A student's belief that is incorrect from the perspective of the scientific community is termed as misconception. The process of replacing a misconception with a scientifically acceptable concept is called conceptual change. Through the use of questions both oral and written before a lesson, the teacher can elicit students' prior knowledge in a concept. According to Smith (2003), four conditions must be present to bring about conceptual change: The student must be dissatisfied with the current understanding, the student must have an available intelligible alternative, the alternative must seem plausible to the student and the alternative must seem fruitful (useable) to the student.

Conceptual change can be improved in students if: The science teacher must use teaching methods made up of open-ended inquiry that involve students in discussions of scientific ideas in accommodating group work, teacher create chances for students to deal with their own beliefs with ways to resolve any conflicts between their ideas and what they are now experiencing in a laboratory activity and/or discussion thereby helping them to make room for this new concept with what they already know and the teacher make connections between the concepts learned in the classroom with everyday life.

Woolfolk et al., (2007), revealed in a study which stated that- "David Ausubel (1968), theorized that people acquire knowledge primarily by being exposed directly to it rather than through discovery". In other words, Ausubel believed that understanding concepts, principles, and ideas are achieved through deductive reasoning.

Ausubel's believes that learning of new knowledge relies on what is already known. That is, construction of knowledge begins with our observation and recognition of events and objects through concepts we already have. We learn by constructing a network of concepts and adding to them. Ausubel also stresses the importance of reception rather than discovery learning, and meaningful rather than rote learning. Similarly, the philosopher believed in the idea of meaningful learning as opposed to rote memorization. The most important single factor influencing learning is what the learner already knows. This led Ausubel to develop an interesting theory of meaningful learning and advance organizers (Ausubel, 1968). An advance organizer is information presented by an instructor that helps the student organize new incoming information.

**2.7 The Role of Pupils' Prior Knowledge in Teaching and Learning**

Background knowledge can simply be explained as the raw material that conditions learning and it acts as mental hooks for the lodging of new information and is the basic building block of content and skill knowledge. Some authors defined prior knowledge as what a person already knows about the content (Marzano, 2004; Stevens, 1980). By the time they enter school, learners have constructed informal theories about how things work, about themselves, and about others (Bransford, Brown and Cocking, 2000; Carey and Gelman 1991; Donovan and Bransford, 2005; Gardner, 1991). Cognitivists' researchers were of the view that learners construct knowledge and that the knowledge they already possess affects their ability to learn new knowledge. If new knowledge battles with prior knowledge, nothing will be understood by the learner. For this reason, teachers must really consider pupils preconceptions when preparing to teach.

Most instructors focus remarkable strength on the content to be taught, overlooking what the pupils bring on bored during teaching and learning. Most at times, little preparation and instructional time is devoted to accessing preexisting knowledge. This blunder can have major repercussions. To turn a blind eye on learners' prior knowledge probably means that, the message envisioned by the teacher will not be understood by the pupils. Previous knowledge of the pupils will have consequences on how the teacher and pupils engross with the teaching and learning materials. The main purpose of education is to correct pupils' misconception and give them the right intervention. Strangman and Hall (2004), maintained that a significant purpose of education is to correct students' erroneous notions. If the teacher knows what the pupils bring to the learning environment, it will be easier to put measures down to remedy it. From AAAS (1990), students existing ideas prior to the teaching and learning of any new knowledge lay the foundation for the construction of the new knowledge. Hence the learners learn the new knowledge by creating a linkage between the new and the existing knowledge or restructuring the new and the existing knowledge.

**2.8 A Naive View of Change of States of Matter and Mixtures**

Pupils have a number of naive views of matter. Pupils are of the view that there are more than three states of matter. 'There are more than three kinds of stuff', direct sensory experience leads children to a naive view of matter involving more than three states (Kind 2004). From the study, the pupils suggested that there were different kinds of stuff: iron, water, wood, meat, stone, sand etc. The study further explained that the pupils believed that the following exist in different kinds of physical state: solid, liquid, powder, paste, jelly, slime; paper-like etc. Each kind of stuff has a usual state: iron, solid, water, liquid, sand is powder, etc., but this can sometimes be changed. For example, many stuffs melt if you make them hot enough...and others burn, any liquid freeze if you make it cold enough, any solid can be powdered, there is no obvious standard way of changing a powder to a solid and some solids decompose (change slowly into some other substances; or mature, i.e. change slowly into other useful substance).

Some researchers have found evidence to support Hayes view of children seeing more than three states of matter. Kind (2004), also examined the conceptions children aged between 5 and 12 years had of `solid' and `liquid' and found evidence to support Hayes' view. According to the authors, children think of like metals and wood as typical solids. To them, substances which are not hard and rigid cannot be solids, so classifying solids which do not "fit" this image is difficult. These researchers found that 50% of 12 and 13 year olds classify non-rigid solids such as dough, sponge, sand and sugar separately from coins, glass or chalk. The authors suggested that: 'The easier it is to change the shape or the state of the solid, the less likely it is to be included in the group of solids'.

Water is the standard "liquid" against which other possible liquids are compared. Children found out that powders have liquid properties but do not give out a sensation of wetness, so categorize these independently. Children see water as a typical liquid. Stavy and Stachel (1985), once again found out that in general, children classify new liquids more easily than solids, perhaps because liquids are less varied in their physical characteristics.

Children appeared to depend solely on sensory information when thinking about matter up to the age of around 14 years. Abstract ideas such as ideas about particles are not readily used to answer questions about the properties of matter, so children persist in thinking that substances are continuous. Millar (1989) cited in Kind (2004), suggested that children do not need to use particle ideas because their own theory of matter has worked perfectly well for them. This has implications for influencing change in students' ideas.

Children have difficulties in accepting the existence of gases such as air because of their invisibilities. They cannot be torched or seen. According to Stavy (1988), invisibility prevents children from forming a concept of gas spontaneously. The study found that instruction is needed for children to acquire knowledge about gas properties, whereas the author's earlier work suggested that children learn intuitively about solids and liquids. Hayes did not characterize gases. Kind (2004) also investigated the ideas 11 year olds have about gases prior to teaching. The study found out that children associated gases with the use and function of objects, like footballs, tyres and suction pads. Also, air was frequently described as being alive, for example, "air always wants to expand everywhere". These ideas may arise through experience of draughts and wind as well as using air around the home.

Kind (2004), studied the naive ideas of children about the properties of matter" 'Stuff' can disappear but its taste and smell stay behind. The study formulated children's naive view of matter as follows;

a. Matter has no permanent aspect. When matter disappears from sight (e.g. when sugar dissolves in water) it ceases to exist.
b. Matter has a materialistic core to which various random properties having independent existence are attached. Matter can "disappear," whereas its properties (such as sweetness) can continue to exist completely independently of it.
c. Weight is not an intrinsic property of matter. The existence of weightless matter can be accepted.
d. Simple physical transformations (such as dissolution) are not grasped as reversible." (Stavy, 1990a).

A number of researchers such as Russell *et al* (1989 and 1990), supported the above evidence. In the study, children aged 5 - 11 were asked to explain the decrease in water level in a large tank after sunny weather. About 45% focused on the remaining water, seeing no need to explain where the "missing" water had gone. For these children, the matter had simply ceased to exist. Stavy (1990a), studied 9 - 15 year olds' abilities to conserve weight and matter. The author's students were shown propanone evaporating in a closed tube. About 30% of 9 - 10 year olds thought the propanone disappeared. 30% of the 10 - 12 age group (30%) thought the smell of the propanone remained, although the matter vanished, Stavy (1990a), cited in Kind (2004). Prieto *et al* (1989) cited in Kind (2004), also reported that 44% of 14 year olds think a solute "disappears" when dissolved, while 23% label the event "it dissolves" with no explanation. A further 40% of this age group in the Stavy (1990a) study thought that propanone became weightless because it had become invisible. By age of 15, the author found out that 65% view the evaporation of propanone as reversible, with a large jump in proportion from 25% to 60% at age 13 - 14 when formal teaching about particle ideas was received. The implication of the above research by Hayes (1979) and Piaget and Inhelder (1969), for teaching on the naive view of children about states of matter and the chances of the states of matter are:-

- Children do not reason consistently - they may use sensory reasoning on some occasions and logical reasoning on others;
- Sensory experience dominates in cases where the matter is not visible; leading to the fact that many students aged 15 and over still use sensory reasoning about matter, despite being well advanced in thinking logically in other areas, such as mathematics.

Some of the prior ideas pupils have about mixtures are; when mixing solutions a chemical change will always occur to change solution to another liquid, solvent in a solution disappears when mixed with the solute and solutes absorb the solvents in solution and disappear. Kind (2004), reported a confusion of state versus chemical change. The author found out that around 70% of 14 year olds and over 50% of 16 year olds thought diluting a strong fruit juice drink by adding water was a chemical change. Some pupils are also of the view that when sugar dissolves in water, it has formed a new substance.

Pupils have difficulties in identifying various mixtures that are found in or around the homes. They see them as different substances after they have mixed up with other substances. Some of the common mixtures found in the home are salad dressing, chocolate chip cookie, concrete, air, detergents, cleaners (formed by adding water to the cleaner), cake mixtures, and gasoline-oil mixtures (for example, lawn mower engines require specific amounts of oil to be mixed with gasoline).

With the above information, the teacher is able to put down measures to correct these misconceptions for proper learning to take place.

## 2.9 Activity-Based Learning and Teaching

Activity-based learning may be defined as a method of instruction, where activities of different types, suitable and relevant to specific subjects are integrated seamlessly into the regular instructional materials and methods to involve students in the teaching - learning or instructional processes and engage them fruitfully (Suydam and Higgins, 1977).

Illeris (2004), defined activity based learning as a process that brings together cognitive, emotional and environmental influences and experiences for acquiring, enhancing and making changes to one's knowledge, skills and world view. When pupils understand and engages with materials and information, it is very easy for learning to take place. For learning to take place, it is very essential for the pupils to be able to processes the information with higher level thinking such as synthesis, application, comprehension, analysis, and metacognition. Gardner (1987), was of the view that when children are able to processes information with higher level thinking, the student is able to relate the information to any life situation, connect it with past learning, build his or her own knowledge and become a knowledgeable and contributing citizen as an adult. Through series of activities, students are able to engage with materials and learning will take place. The students are able to learn well and the information acquired sticks longer because it involves direct experience by the student rather than textbook study. Activity-based learning, ought to allow pupils to participate in the process and get information in such a manner that he comprehends and forms his/her knowledge about a specific subject. The idea of activity-based learning follows the constructivist educational theory and is child-centred pedagogy. Cognitivist involves examining learning, memory, problem solving skills, and intelligence. In this approach, the individual is consciously engaged in the construction of a product (Li, Cheng, and Liu, 2013). The utilization of constructionism in educational settings has been shown to promote higher-order thinking skills such as problem-solving and critical thinking (Li *et al*., 2013). It is seen to create an enabling environment where there are lots of tools to be manipulated to develop skills.

Activity method is a technique adopted by a teacher to emphasize his or her method of teaching through activity in which the students participate rigorously and bring about efficient learning experiences. The activity–based method is a teaching strategy that attempts to assist pupils to discover their own knowledge through an activity (Mensah, 1992). The study further stated that in addition to acquisition of knowledge, the approach also leads to acquisition of process skills such as measuring, recording, analyzing and interpretation of data. Reisman and Payne (1987), were also of the view that activity–based method is more of a child-centred approach, as such; pupils may learn better and faster when they are taught through activities. When a pupil performs an activity as an individual, the learner easily understands and never forgets (Jenkins, 1998).

The teaching of science through activity is not just providing hands-on activities for students. The activity method is used to teach science in which the pupil is placed at the centre of the learning process and made to manipulate materials and experience things for him or herself (Mensah, 1992).

Brown, Hershock, Finelli, and O'Neal (2009), were of the view that not all teaching strategies need to be inquiry-based, but teachers should engage students in the process by asking open-ended questions, encouraging students to make hypotheses, listening to students, supporting their hypotheses with data, and providing time for discussions in small groups or pairs.

An article published in the "Educational Psychologist" stated clearly that activity method is not an effective way to teach (Kirshner, Sweller and Clark, 2006). The study claimed that unguided activities actually cause people to lose memory and that strong guidance is needed. Furthermore, the authors added that not only is unguided instruction normally less effective; there is also evidence that it may have negative results when students acquire misconceptions or incomplete or disorganized knowledge (Kirshner, Sweller and Clark, 2006). In the view of the study, teachers are not supposed to just give activities to the pupils but they should be guided with the appropriate instructions in order to bring out the best of knowledge.

Ncwmann (1996), argued that education aimed at depth in knowledge is more valuable than "curriculum coverage"- a superficial exposure with less opportunity for mastery of a topic. Depth in learning more likely facilitates lasting retention and knowledge transfer. If the pupils understand the concept being taught very well, they can easily recall it anytime and anywhere when necessary. They can easily apply the knowledge to their daily lives. Agboola (2000), has indicated the roles of practical or activity based method in science as follows: encourage accurate observation, careful recording, promote simple, common-sense, and scientific method of thought, develop manipulative skills, give training in problem solving, verify facts and principles already taught, educate on theoretical work as an aid to comprehension, be an integral part of the process of finding facts by investigation and arriving at principles, arouse and maintain interest in the subject.

The activity method of teaching put the pupils at the centre of the teaching and learning process and the pupil is made to engage with teaching and learning materials to ascertain scientific facts, concepts, or principles with or without any teacher support. According to Khan and Iqbal (2011), an inquiry-based science lesson is a student-centered method of teaching which provides students with the opportunity to ask questions and follow instructions to arrive at new knowledge, and provide students in a science class the opportunity to think and reason critically (Pratt & Hackett, 1998). McBride et al. (2004), were of the view that the use of an activity-based lesson such as teaching Physics by inquiry has helped improved the performance of students in Physics who gained admission into the universities. Ergul et al. (2011), found out that combination of hands-on activities and inquiry science teaching help improve the attitude of students towards the study of science. This was based on the fact that the attitude of the students in the experimental group was said to have improved with respect to that of their counterparts in the control group in the study.

The materials used by the students in an activity method lessons are either provided by the teacher or the students (Ministry of Education, Youth, and Sports [MOEYS], 2006). Khan & Iqbal (2011) and Ministry of Education Youth and Sport (2006) stated that, in an activity lesson, the teacher introduces the topic and distributes the teaching learning materials as well as the instructions for the activity for the students to carry out the activity on their own to discover the new scientific concept or idea. The teacher then acts as a co-learner showing interest in the students' activity and go round checking on what the pupils are doing and giving instructions where necessary. Since the pupils are actively involved in the learning process, they gain better understanding of the science concept and as well have better retention of what they have learnt.

According to Brooks & Brooks (1993), when learners are actively engaged in science activities, they often gain better understanding of scientific principles, have better retention, and enjoy the learning process more than when they are taught through passive techniques. This was cited in the North Central Region Education Laboratory (NCREL, 1993), which reported that a new vision of science learning is emerging, one that calls for instructional conceptualizations.

McBride *et al*. (2004), found out that during the training of teachers to teach Science (Physics) by inquiry, the instructors for the programme acted as co-learners by monitoring the teachers involved in the activities and where necessary gave direction to them. According to MOEYS (2006), activity method is the preferred choice of science teaching and learning at the basic school level because it takes advantage of Piaget's concrete operational developmental stage of knowledge construction. Piaget demonstrated that students at the concrete operational stage by nature show peculiar behaviors when at play or using materials within their environment. These students differ in demonstrating such behaviors due to their genetic and environmental factors. Therefore, when activity method is used in teaching science, individual students are allowed to form concepts at their own pace. This helps students to easily remember the concept learnt. Pupils at their formative ages learn very well when actual objects which are reachable to their senses are used in teaching and learning. The use of concrete materials by younger ones equips them with the skill of logical reasoning, manipulation of symbols, and generalization (American Association of the Advancement of Science [AAAS] 1990). The study further stated that students existing ideas prior to the teaching and learning of any new knowledge lay the foundation for the construction of the new knowledge. The students learn the new knowledge by creating a linkage between the new and the existing knowledge or restructuring the new and the existing knowledge. The study again made it clear that activity method is said to make use of the linkage and reconstruction of the new and existing knowledge. Clark (2003), observed that in a primary school science lesson, the activity the students engaged in was based on materials which were simple and familiar to the students.

AAAS (1990), again stated that activity method of science teaching gives students sufficient time to carry out the activity in discovering the new knowledge. Hence, AAAS (1990) asserted that the teaching and learning of science should be carried out in such a way that students will have enough time to explore, observe, collect, sort, test ideas, measure, record, draw, interview, survey, compute, and to skillfully handle scientific equipment. This enhances students' retention of scientific concepts, and hence, the students' performance in science concepts. According to Wadsworth (1989), people followed the theoretical approach due to limited knowledge of science that the pupils possessed. The author again, stated in modern times, science is seen more to be practically oriented or activity based. Pupils enjoy science lessons when they are involved in activities concerning the topic. There is therefore the need to adopt the activity–based and inquiry methods in the teaching of science especially at the basic and secondary levels (Reisman & Payne, 1987).

Nevertheless, there are, and have been for some time now, concerns about practical work in school science. Some are of the view that teacher's waist a lot of time organizing such activities and are unable to complete the syllabus. (Osborne, 1998 and Osborne & Dillon 2008), stated that a lot happens under the guise of practical work and is frequently a relatively ineffective use of teaching time and has repeatedly failed to train students in the science skills needed for the 21st century and has failed to provide learners with an adequate understanding of scientific theories or of how science works. Ofsted (HMI/Ofsted, 2004a/b), stated that scientific enquiry in primary schools is both variable and vulnerable and that, at secondary level, the range of investigations are narrow and is dominated by the perceived demands of assessed coursework beyond Year eight. These trepidations have been endorsed by some units of the science community, educationalists, industries, businesses, students and some teachers as well.

Wellington (1994), noted several counter arguments to all these claims for practical work/activity method in teaching science concepts. Firstly, doing science and understanding science theories were different (Theobald, 1968; Leach and Scott, 1995). Secondly, there was evidence that many pupils, particularly girls, are not very positive about doing experiments (Murphy, Qualter et al., 1990). Thirdly, evidence for the transferability of skills was limited (Ausubel, 1964; Chapman, 1993; Lave, 1998).

The author also noted that the arguments for the value of practical work in promoting group work have also been criticized.

These arguments for and against practical work or hands on activities must be dealt with very well by those that matter when it comes to science education and must engage in consideration of the purpose of science education and, in particular, the aims and purpose of 'practical work'. Some authors such as Bennett and Kennedy (2001), pointed out, the plurality of espoused aims for practical work in science make the task of assessment very difficult. Maybe it is time to see the laboratory as only an aide-de-camp and not a necessity. That the learning of science is not dependent on a practical offering for every lesson (Osborne, 1998)

In a broad-spectrum, teachers and students are very positive when it comes to hands on learning. A NESTA survey with a total of 510, 99% of the sample of UK science teachers believed that enquiry learning had a positive impact (83% - 'very'; 16% - 'a little') on student performance and attainment (NESTA, 2005). Lunetta *et al*., (2007), was of the view that the quality of practical work varies considerably but there is a strong evidence, from this country and elsewhere, that: 'When well-planned and effectively implemented, science education laboratory and simulation experiences situate students' learning in varying levels of inquiry requiring students to be both mentally and physically engaged in ways that are not possible in other science education experiences'.

Brown (1985) gave some examples of activity methods of teaching as discussions, demonstrations, enquiry, questions and answers, role play etc. To be a successful teacher, learning must include all three of these crucial factors: activity (practice), concept (knowledge), and culture (context) (Brown *et al*., 1989).

### 2.9.1 Discussion Method

According to Hake (1998), discussion as a teaching strategy is one of the best ways of helping pupils to understand. The study was of the view that when pupils are given the chance to talk about things, it becomes easier to find out their knowledge in that topic. Discussion could comprise of an entire class, two or more classes, an entire school, smaller groups or two or three pupils. This enables both the teacher and pupils to have fruitful interactions based on valid reasoning. During the discussion, the teacher only act as a facilitator to help the pupils bring out their ideas on the specific topic. In order that learners see clearly how an idea applies to everyday life, they must be given the opportunity to use the discussion approach, and that the teacher only acts as a catalyst during the interaction among the students (Akpan, 1992). This method provides an excellent opportunity for pupils to practice their oral communication skills and encourages critical and evaluative thinking.

The Discussion Method demands that pupils come to class very well prepared, compelling them to think out their arguments in advance and to answer their peers' questions and counter-arguments. It improves their powers of thinking, analysis, and articulation. It thus provides them with fundamental skills necessary for success in any discipline or profession. Class discussions can motivate students while also helping them retain knowledge and develop effective problem-solving abilities.

Apart from field trips, discussion method can also be used to augment demonstration method during teaching and learning by grouping pupils to solve a given task. Siyakwazi and Siyakwazi (1999), propound that the discussion method permits a greater degree of cooperation amongst the learners. Discussion promotes communication and exchange of ideas among students.

### 2.9.2 Demonstration Method

Demonstration method is a type of pupil-centred lesson which includes the teacher doing or presenting something (a lesson) to the whole class or pupils in order to show a principle works. The goal of this strategy is to help pupils acquire skills and recognize how to solve problem when unexpected obstacles or problems arise. When using demonstration model in the classroom, the teacher, or some other expert in the subject being taught, performs the tasks step-by-step first, so that the learner eventually repeat the process to complete the same task individually. Demonstrations can be used to provide an example that improves teaching and to offer effective hands-on, inquiry-based learning opportunities in classes or in laboratories.

Science educationists like Smith (1990), agreed that demonstration method is an essential aspect of science teaching. According to Gall, Borg and Gall (1996), once the concepts are firmly established, the other higher-order varieties of learning like problem solving can also take place. Chikuni (2003), was also of the view that demonstration method should be prepared thoroughly to avoid any kind of error, as it may be difficult to correct. During demonstration, the teacher must explain each step very well and give clearer directions in every step. Gatawa (1994), suggested that when demonstrating, the teacher must explain the reason for the significance of each step. In order to have a very fruitful demonstration, the teacher must plan it prior to the lesson. This is to ensure that all necessary steps are sequentially arranged (Chamberlain & Kelly 1981). However, Kim and Kellough (1995), proposed that, the teacher should involve the pupils when demonstrating. Involvement can be through asking students questions. If teachers go round to inspect pupils work and realize that they are not doing the right thing, they are supposed to demonstrate again in order to make sure that the right thing is done. Gwarida (1993), suggested that teachers need to re-demonstrate where pupils are failing to reproduce the skills required of them.

Advantages of demonstration method of teaching comprise of the capability for participants to see, observe, touch, feel and take part straight in the learning process and the enhanced learning ability of those being instructed. Disadvantages of the method are the risk of too many participants being involved and a potential shortage of time, resources and facility space, which limits the hands-on opportunities of the participants.

### 2.9.3 Question and Answer Method

Question and Answer method of teaching science is a vital teaching approach used to develop attributes in pupils in scientific inquiry.

Jateline (2010), pointed out some advantages of pupils-teacher classroom interaction through questioning. According to the study, some advantages of question and answer method of teaching are – it can be used in all teaching situations, it is quite an easy method to use when no other suitable teaching method is available, it serves as a guide to a check on preparation of assignments, it can be used to reflect student's background and attitude, it is helpful to establish the personal problems of the students and it helps in developing the power of expression of the students.

This means that questioning is the entry point to solution formulation in inquiry, promote participatory learning, good communication skills, and confidence building in pupils' learning process. Pupils must be assisted in order to develop very good questioning and answer skill. One good strategy of engaging pupils in science lesson is by prompting them to answer questions or ask questions. If the pupils are able to ask questions they would be able to clear what is bothering their minds and the teacher is be able to resolve misconceptions and check understanding.

Although questioning technique is a valuable instructional strategy, it can impede learning when it is poorly constructed. Some disadvantages are - it requires a lot of skills on the part of teacher to make a proper use of this method, it may sometimes destroy the atmosphere of the class, this method is mostly quite embarrassing for shy pupils and it is time wasting (Jateline 2010).

### 2.9.4 Concept Mappings

A concept map is a method of representing connections between ideas, images, pictures, or words in the same way that a sentence diagram represents the grammar of a sentence, a road map represents the locations of highways and towns, and a circuit diagram represents the workings of an electrical appliance. Each word, phrase, image or picture in concept map links to one another and links back to the original idea, word, phrase, picture or image.

A concept map or conceptual diagram is a diagram that depicts suggested relationships between concepts. It is a graphical tool that instructional designers, engineers, technical writers, and others use to organize and structure knowledge. The idea of concept mapping as a learning tool was developed by Novak (1991) when the author was exploring the changes in children's knowledge of Science. This idea was derived from Ausubel's (1968) cognitive theory which places central emphasis on the connection of pupils' existing knowledge as the anchor for subsequent meaningful learning. Concept map is a useful tool for organizing and visually representing interrelated structure of concepts within a domain of knowledge.

### 2.9.5 Cooperative learning

Cooperative learning is an educational approach which aims to organize classroom activities into academic and social learning experiences. In cooperative learning, there is arrangement of students into groups to perform a task toward academic goals.

Unlike individual learning, which can be competitive in nature, students learning cooperatively can capitalize on one another's resources and skills, asking one another for information, evaluating one another's ideas and monitoring one another's work, Chiu (2008). Furthermore, the teacher's role changes from giving information to facilitating students' learning. Everyone succeeds when the group succeeds. Ross and Smith (1995), describe successful cooperative learning tasks as intellectually demanding, creative, open-ended, and involve higher order thinking tasks.

Johnson, Johnson, & Holubec (1994), identified five essential elements for successful incorporation of cooperative learning in the classroom: positive interdependence, individual and group accountability, promotive interaction (face to face), teaching the students the required interpersonal and small group skills and group processing.

According to Brown and Ciuffetelli (2009), cooperative learning requires students to engage in group activities that increase learning and adds other important dimensions. The study also made it clear that the positive outcomes of cooperative learning include academic gains, improved race relations and increased personal and social development. The authors also made it clear that students who fully participate in group activities, exhibit collaborative behaviors, provide constructive feedback, and cooperate with their groups have a higher likelihood of receiving higher test scores and course grades at the end of the semester. Tsay, Mina et al (2010), were of the view that cooperative learning is an active pedagogy that fosters higher academic achievement. The authors further went on to state that cooperative learning can increase attendance, time on task, enjoyment of school and classes, motivation, and independence, Augustine, Gruber, & Hanson (1989-1990); Good, Reys, Grouws, & Mulryan, (1989-1990); Slavin, (1990); Wood, (1987).

Brown and Ciuffetelli (2009), listed the benefits and applicability of cooperative learning: they are students demonstrate academic achievement, cooperative learning methods are usually equally effective for all ability levels, cooperative learning is effective for all ethnic groups, student perceptions of one another are enhanced when given the opportunity to work with one another, cooperative learning increases self-esteem and self-concept, and ethnic and physically/mentally handicapped barriers are broken down allowing for positive interactions and friendships to occur.

According to Johnson and Johnson (1989), cooperative learning results in increased higher level reasoning, increased generation of new ideas and solutions and greater transfer of learning between situations.

Cooperative Learning has many limitations that could cause the process to be more complicated than first perceived. According to Sharan (2010), constant evolution of cooperative learning is a threat. Because cooperative learning is constantly changing, there is a possibility that teachers may become confused and lack complete understanding of the method. Also teachers can get into the habit of relying on cooperative learning as a way to keep students busy. While cooperative learning consumes time, the most effective application of cooperative learning hinges on an active instructor.

### 2.9.6 Simulation

According to Banks, Carson, Nelson and Nicol (2001), simulation is the imitation of the operation of a real-world process or system over time. The act of simulating something first requires that a model be developed; this model represents the key characteristics, behaviors and functions of the selected physical or abstract system or process. The model represents the system itself, whereas the simulation represents the operation of the system over time.

Simulation is used in many contexts, such as simulation of technology for performance optimization, safety engineering, testing, training, education, and video games. Often, Simulation can be used to show the eventual real effects of alternative conditions and courses of action.

Simulation technique involves initiating activity that resembles real life situations in teaching certain science concepts and ideas. Physical simulation refers to simulation in which physical objects are substituted for the real thing, (Sokolowski Banks, 2009). These physical objects are frequently selected because they are smaller or cheaper than the real object or system.

Simulation technique can take the form of a role-play, games, and models (Yardley-Matwiejczuc, 1997). During teaching, the teacher can ask some of the pupils to act as scientists especially when it demands that the pupils should be able to take decisions or plan so as to solve a problem. Erinosho (2008), stated that pupils could act as scientists in a situation that requires a decision or planning to solve problems through role-play and develop basic /generic skills in pupils. The use of games and role play can really help pupils to develop a number of skills such as analytical, communication, and decision-making. According to Yardley and Matwiejczuc (1997), games and role-play helps pupils to develop analytical, communication, and decision-making skills, as well as to build confidence in discussions on science issues. Simulation can also be used to show the eventual real effects of alternative conditions, courses of action, when the real system cannot be engaged because it may not be accessible, or it may be dangerous or unacceptable to engage, or it is being designed but not yet built, or it may simply not exist (MarcLevoy, 2007).

**2.10 Factors Affecting Pupils' Performance**

The performance of pupils in schools depends on several factors. Walters and Soyibo (1998), stated that student performance is very much dependent on (socio economic background) (SEB). According to Hansen (2000), student performance is affected by different factors such as learning abilities because new paradigm about learning assumes that all students can and should learn at higher levels but it should not be considered as constraint because there are other factors like race, gender, sex that can affect student's performance. Pallas, Natriello, and McDill (1989) linked between students' achievements, economic circumstances and the risk of becoming a drop-out t proved to be positive. Meaning the performance of pupils can be linked to the economic circumstances of the pupils. A child from a more affluent home is more likely to go through the educational ladder to the end than a child from a poor home. The later can easily become a drop-out. Age, qualification distance from learning place etc. can also have positive or negative influence on the performance of pupils.

The attitude of pupils can have a direct effect on the academic performance of the pupil. Pupils with very positive attitude towards learning can achieve academic excellence while those with poor attitude such as impertinence will not excel academically. Kirby *et al*. (2002), focused on student's impatience (his time-discount behavior) that influences his own academic performance.

Classroom arrangement whereby weak pupils are in groups with their fellow weak pupils can help improve their performance. Zajonc's (1976), analysis of older siblings shows that students' performance improves if they are with the students of their own kind. It means that pupils will be more comfortable with those whose academic performance is similar to theirs than those whose academic performance is higher or lower their academic performance. Zimmerman (1999, 2001), however had contradictory view. The author stated that students' performance depends on number of different factors, it says that weak peers might reduce the grades of middling or strong students. Thus when you mix weak and strong students, the weaker ones will pull the stronger ones to his or her standard.

**2.11 Pedagogical Content Knowledge of Teachers in Science Concepts**

According to Ayeni (2011), teaching is a continuous process that involves bringing about desirable changes in learners through use of appropriate methods. Chang (2002) Sustained that teaching methods work effectively mainly if they suit learners' needs since every learner interprets and responds to questions in a unique way.

The primary purpose of teaching at any level of education is to bring a fundamental change in the learner (Tebabal & Kahssay, 2011). In order to enhance the process of knowledge transmission from teachers to pupils, there is the need to employ appropriate teaching methods that best suit specific objectives. According to Hightower et al (2011), questions about the effectiveness of teaching methods of student learning have consistently raised considerable interest in the thematic field of educational research. Quite remarkably, regular poor academic performance by the majority of the students is fundamentally linked to application of ineffective teaching methods by teachers to impact knowledge to learners (Adunola, 2011). Njoku (2005b), stated that one of the factors which accounts for students' poor performance and fear in chemistry is poor teaching methods. This means that in teaching mixtures and change of state of matter which falls under chemistry in integrated, the teachers' knowledge on the subject and the method employed normally known as pedagogical content knowledge is very essential in teaching and learning of science. The success of using activities in learning mixtures and change of state of matter cannot be exempted from the teachers' prior content knowledge and methodology. If the teachers don't use the best methods in teaching, poor performance of pupils will be the end result. If the teacher also knows all the best teaching methods and lack knowledge in the content being taught, same poor performance will result.

Shulman (1986), explained pedagogical content knowledge (PCK), as a form of practical knowledge that is used by teachers to guide their actions in highly contextualized classroom settings. Pedagogical content knowledge is a special combination of content and pedagogy that is uniquely constructed by teachers. According to Gudmundsdottir (1987a, b), pedagogical content knowledge is a form of knowledge that makes science teachers teach more than scientists .This means teachers differ from scientists, not necessarily in the quality or quantity of their subject matter, but in how that knowledge is organized and used. In other words, an experienced science teacher's knowledge of science is organized from a teaching perspective and is used as a basis for helping students to understand specific concepts.

The transformation of subject matter for teaching (Shulman, 1986) occurs as the teacher critically reflects on and interprets the subject matter; finds multiple ways to represent the information as analogies, metaphors, examples, problems, demonstrations, and classroom activities; adapts the material to students' abilities, gender, prior knowledge, and preconceptions (those pre-instructional informal, or nontraditional ideas students bring to the learning setting); and finally tailors the material to those specific students to whom the information will be taught.

Recently, there has been a renewed recognition of the importance of teachers' science subject matter knowledge, both as a function of research evidence (e.g., Ball & McDiarmid, 1990; Carlsen, 1987; Hashweh, 1987), and as a function of literature from reform initiatives by the Holmes Group (1986) and the Renaissance Group (1989). Not surprisingly, it has become clear that both teachers' pedagogical knowledge and teachers' subject matter knowledge are crucial to good science teaching and student understanding (Buchmann, 1982, 1983; Tobin & Garnett, 1988). Cochran, DeRuiter, and King (1993), revised Shulman's original model to be more consistent with a constructivist perspective on teaching and learning. The study described a model of pedagogical content knowledge that results from an integration of major components which are subject matter knowledge, pedagogical knowledge, teacher knowledge and teachers' knowledge of students' abilities and learning strategies, ages and developmental levels, attitudes, motivations, and prior knowledge of the concepts to be taught.

Carpenter, *et al*., (1988), also stated that novice tends to make broad pedagogical decisions without assessing students' prior knowledge, ability levels, or learning strategies. Some research that has stemmed from the introduction of PCK has attempted to address the question of how pre-service teachers learn to teach subjects that they already know or are in the process of acquiring (Magnusson, Borko & Krajcik, (1994); Mark, (1991); Grossman, 1990).

**2.12 Using Teaching and Learning Materials (TLMs)**

Teaching learning materials are described as aids materials used in teaching for illustrative purposes. Amoatey (2001), stated that the ultimate goal of teaching learning materials are to facilitate and demonstrate an understanding of a lesson. Teaching and learning materials can be defined to comprise of all materials which contribute to the teaching and learning process. Learning takes place using the five senses which are seeing, hearing, smelling, tasting and feeling. Atiku (2004), was of the view that any medium which gives learners the opportunity to use many senses as possible is the best medium of learning. The use of teaching and learning materials stimulate the curiosity of pupils in what is being taught and make understanding and remembering concepts easier. Teaching and learning materials also help the teacher in explaining difficult concepts and pupils are also encourage to find more on their own and thereby stimulating self-learning. According to Amoatey (2000), teaching and learning materials are divided into three groups; these are audio materials, aids that appeal to the sense of learning. Examples are radio, cassette recorders, drum etc. Visual materials are those that appeals to the sense of sight, examples are real objects (relia), chalks, textbooks, charts. The last group is the audio-visual materials which appeal to both the sense of sight and hearing; examples films, video, television etc.

Using teaching and learning materials to teach science brings diversity, multiplicity, curiosity, attentiveness, concentration, awareness and interest among pupils to assist retention and recall. Pupils easily forget what they hear but what they see remains in their minds for a very long time. Confucius gave a practical statement on how the human mind approaches the learning process: I hear and I forget, see and remember, I do and I understand (ITE Teachers Conference Report, 2005).

Teaching and learning materials therefore play an important role in the teaching and learning of science and must therefore be taken very seriously as a nation. Inadequate logistics such as TLMs (text books, story books and computers among others) are having a toll on education performance at the basic school level and were impacting negatively on the quality of teaching and learning. All stake holders of the education sector must therefore be brought on board to make sure that our schools are well resourced with the appropriate teaching and learning materials. Ossei-Anto (1999), stated that, science teaching and learning will definitely be better done if the issue of inadequate supply of science equipment and materials is tackled with zeal. The author further explained that, learning by doing is one of the cardinal principles of teaching science.

**2.13 Teaching Syllabus for Integrated Science (Primary 4-6)**

Some of the general aim of integrated science syllabus for upper primary is to develop the spirit of curiosity, creativity and critical thinking, develop skills, habits of mind and attitudes necessary for scientific inquiry and to design activities for exploring and applying scientific ideas and concepts. The broad topics to be treated are energy and interactions of matter. The sub-topics to be treated under energy are-forms of energy, conversion of energy, light, change of state of matter and basic electronics. The general objectives for energy are: to show understanding that energy has a source, can be transferred and can be transformed into various forms of energy, recognize that the sun is a major source of energy on earth, show understanding of how energy is converted from one form to another, show understanding that matter can change from one form to another (MOESS, 2007).

The specific objectives for change of state of matter are: explain the term matter, describe the three states of matter, and investigate how matter changes from one state to another (MOESS, 2007).

The general objectives for interactions of matter are: to appreciate that interaction between and within matter helps humans to better understand the environment and their role in it, develop skills in the formation and separation of mixture, be aware of the uses of mixtures in the home and industry, be aware of the symptoms of some water related diseases and their prevention, and recognize the causes, effects and prevention of HIV/AIDS (Ministry of Education Science and Sports, 2007).

The specific objectives for mixtures are: demonstrate the formation of mixtures, identify appropriate methods for separating a particular mixture, and list some uses of mixtures in industry and in everyday life (Ministry of Education Science and Sports, 2007).

The syllabus help the pupils in primary 5 appreciate mixtures in their daily lives and how matter can change from one state to the other by the application of heat or reduction of heat. According to Ministry of Education, Science and Sports 2007 mixtures and change of state of matter are introduced in primary 5 under section 4 and section 5 of the teaching syllabus for Integrated Science upper primary level. Change of state of matter is treated under matter, states of matter and change of state of matter. Mixture is treated under formation of mixtures, types of mixtures, methods of separating mixtures and application of the formation and separation of mixtures (Ministry of Education Science and Sports, 2007). The rationales for teaching natural science are: science and technology form the basis for inventions, for manufacturing and for simple logical thinking and action. This means that scientific and technological literacy is necessary for all individuals, especially in developing countries which have to move faster in the attempt to raise the standard of living of their people. Natural science is a fusion of the major branches of science. Its study at the basic education level will equip the young person with the necessary process skills and attitudes that will provide a strong foundation for further study in science at the upper primary level and beyond. It will also provide the young person with the interest and inclination toward the pursuit of scientific work (Ministry of Education Science and Sports, 2007).

# CHAPTER THREE

# METHODOLOGY

## 3.0 Overview

The chapter is about methods and procedures used in acquiring information and data for the research work. The chapter is organized under the following subheadings; research design, study area, population, sample and sampling procedures, research instruments for data collection, validity and reliability of instruments, data collection and data analysis procedures.

## 3.1 Research Design

The research design used was an action research. The method used to collect data was the mixed method. Mixed method research combines qualitative and quantitative method in ways that draw on the strengths of both traditions of inquiry. It is a clear step away from the boundaries and practices of those traditions, especially those linked to quantitative method. Onwuegbuzie and Johnson (2004), defines mixed method research as the class of research where the researcher mixes or combines quantitative and qualitative research techniques, methods, approaches, concepts or language into a single study. Mixed method research is also an effort to formalize the use of several methods in answering research questions, rather than limiting or constraining researchers' choices.

Bogden and Biklen (1992), stated that action research is the systematic collection of information that is designed to bring about change. Cohen, Manion, and Morrison (2005), also stated that action research can be used to evaluate a variety of areas such as teaching methods. Data was collected through class test, group work, class exercises and observation. The use of both quantitative and qualitative research approach in the same study is referred to as a mixed-method design. According to Creswell and Clark (2011), mixed method research "focuses on collecting, analyzing, and mixing both quantitative and qualitative data in a single study or series of studies. Its central premise is that, the use of quantitative and qualitative approaches provide a better understanding of research problems than either approach." The study further stated that the characteristics of mixed methods research are collecting and analyzing both quantitative and qualitative data, mix two forms of data in different ways, give priority to one or both forms of data and can be in a single study or in multiple phases of a study. This method gives greater strength to a study rather than just using one approach

### 3.2 The Study Area

The study was conducted in Effutu Municipal Assembly primary school in the Central region of Ghana. The Effutu Municipality is one of the 20 administrative districts in the Central region of Ghana. The Municipality lies between the Gomoa East District to north, west and eastern side. On the southern side is the Gulf of Guinea. The administrative capital is Winneba, a town renowned for its specialised major institutions of higher learning.

From the records of Effutu Municipal Education Directorate, the percentage of candidates who passed B.E.C.E. from 2010-2013 were 52.57%, 62.95%, 52.71%, and 44.44% respectively. This means the candidates who failed the B.E.C.E. from 2010-2013 were 47.43%, 37.05%, 47.29%, and 55.56% respectively. Effutu Municipal Education Basic Education Certificate Examination- 2016 general performance revealed that; 51.3% of candidates passed in Integrated Science while 48.7% failed in integrated science in the municipality. Six hundred and twenty-one

(621) candidates failed in integrated science out of 1275 candidates presented. The percentage passed in the other subjects (R.M.E., B.D.T., English Language, Fante, I.C.T, social Studies, Mathematics, French) were 72.5%, 67.5%, 57.7%, 54.8%, 52.3%, 44.7%, 41.9%, and 20.5% respectively.

From North campus on the main road towards Central campus, Effutu Municipal Assembly Primary School can be located on the left side of the road, just about three hundred meters to the traffic light in a suburb called Kojo-beedu, right opposite Town Hall.

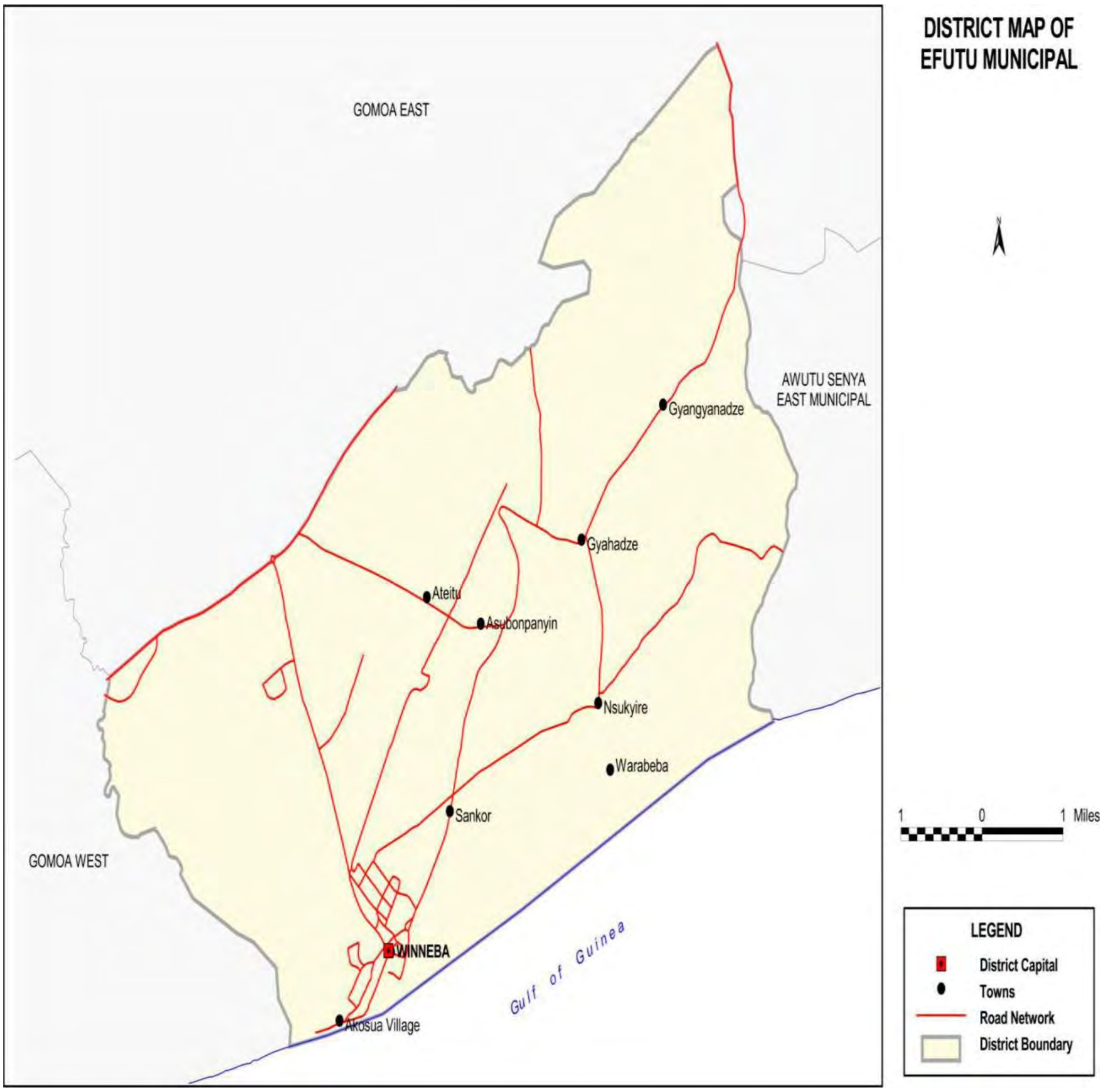


**Figure 1: Map of Effutu Municipality**

### 3.3 Population

Polit and Hungler (1999), referred to population as the totality of all subjects that conform to a set of specifications, comprising the entire group of persons that is of interest to the researcher and to whom the research results can be generalized. The targeted population was all primary five pupils in the Effutu Municipality. The size of the population was thousand three hundred and thirty-two (1332). The accessible population was primary five pupils of Effutu Municipal Primary School. This school was chosen for the study because the researcher was very familiar with the area and the pupils in the school.

### 3.4 Sample and Sampling Procedures

Burns and Grove (2003), referred to sampling as a process of selecting a group of people for a study. Polit *et al.* (2001), confirmed that in sampling, a portion that represents the whole population is selected. Sampling can further be explained as a process or technique of choosing a sub-group from a population to participate in the study; it is the process of selecting a number of individuals for a study in such a way that the individuals selected represent the large group from which they were selected (Ogula, 2005). LoBiondo-Wood and Haber (1998), stated that a sample is a portion or a subset of the research population selected to participate in a study, representing the research population.

Due to resources and time constraint, non-probability and purposive sampling techniques were used in choosing the participants for this study. Parahoo (1997), stated that in a non-probability sampling, the researchers use their judgment to select the subjects to be included in the study based on their knowledge of the phenomenon. Convenience sampling was used in selecting the location for the study which was Effutu Municipal Assembly Primary School and the participants of the study (i.e. primary five). Primary five pupils were selected for the study because it was believed that, by that stage, they had covered much and more oriented with the upper primary school science syllables as compared to primary four pupils. Two Primary five classes (5A and 5B) were purposively selected because, the participants treated mixtures and change of state of matter during the period of the study and the two classes must be taught the same topics using the same method since the participants wrote the same exams at the end of the term. The research sample size consisted of sixty-three (63) primary five/ basic five (A5/B5) pupils of Effutu Municipal Assembly Primary School. The number of females was twenty-three and the boys were forty.

### 3.5 Data Collection Procedure

After the participants were selected purposively for the study, the participants were given about twenty-five minutes of lessons in some selected science topics such as mixtures and change of state of matter. After the lessons, participants made oral presentations, did classes exercises and wrote science test on mixtures and change of state of matter. The initial scores on the oral presentation and science test were recorded. The participants were taught the same topics using series of activities.

### 3.6 Research Instruments

Two separate instruments were used to test pupil's comprehension and performance in some science concepts. Oral presentation and science test were used to test pupils' performance in science concepts.

### 3.6.1 Oral Presentation Instrument/tool

Oral presentations were used to test pupils' comprehension of science concepts. Pupils were asked to make presentations on some science topics they have learnt.

### 3.6.2 Pre-intervention Activities

A teacher made science test was used in measuring pupils' performance in change of state of matter and mixtures. It was made up of ten objective test items.

A pre-intervention test was administered during the first week of the research by the researcher to measure the performance of the pupils with regards to initial knowledge (preconception) on mixtures and change of state of matter. This phase consisted of two activities which were done to ascertain the level of pupils' performance and understanding of mixtures and change of state of matter. The first activity was a pre-intervention test (appendix A) which was used to test pupils' preconceptions on mixtures and change of state of matter. This was done to know the pupils' misconceptions /preconceptions of mixtures and change of state of matter.

The second activity was revision of some of the concepts learnt in the previous terms after the pre-intervention test. These concepts included heat, water cycle, parts of flowers etc. These lessons took place in the first week of the study with most of the learning activities being oral interactions between the researcher and the pupils (participants).

## 3.7 Pre-Intervention Activities

From the pre-intervention activities, the researcher found out that the problem mainly centered on; lack of activity work, lack of pupils' involvement in the teaching and learning process, lack of pupils interest in science, use of big terminologies in science, poor understanding of science concepts, and the lack of teaching and learning materials. At the end of the pre-intervention activities, the researcher found out that more than have of the pupils have no preconceptions of mixtures and change of state of matter. Just a handle full had some preconceptions about the concepts to be treated. The conceptual understanding of the pupils was nothing to write home about.

### 3.7.1 Intervention Activities

The outcome from the pre-intervention activities compelled the researcher to design interventions that made use of a number of activities to improve pupils' contribution and involvement in the teaching and learning process. The activity method of teaching and learning of science was used to address the low performance of pupils in mixtures and change of state of matter. At the first stage of the intervention, the researcher prepared a sixty minutes (double periods) lesson plan to teach the concepts; change of state of matter in the second week of the study. The pupils in the two classes were put into four (4) groups of sixteen (16) members. Another sixty minutes lesson plan was prepared by the researcher to teach mixtures in the third week. Each of the two classes was taught with the same lesson plan and the same activities depending on the time table.

For each of the 60 minutes activity lesson with the pupils, there were three main activities for which each group performed at the same time. Thus, in the first activity lesson, activities I, II and III were used and activities IV and V, and VI were used for the second activity lesson. Below is how the activities were structured:

### 3.7.2 Investigating Changes of State of Matter

**I**: Investigating boiling and condensation

Materials and apparatus-ice blocks, cooking pan or beakers (or empty tin), a source of heat (Bunsen burner or charcoal fire).

**Procedure**

1. Work in groups of four
2. Put 100g of ice blocks into the pan or beaker.
3. Heat gently until the ice blocks turn to liquid.
4. Continue heating until bubbles begin to escape from the liquid as shown in the picture below.

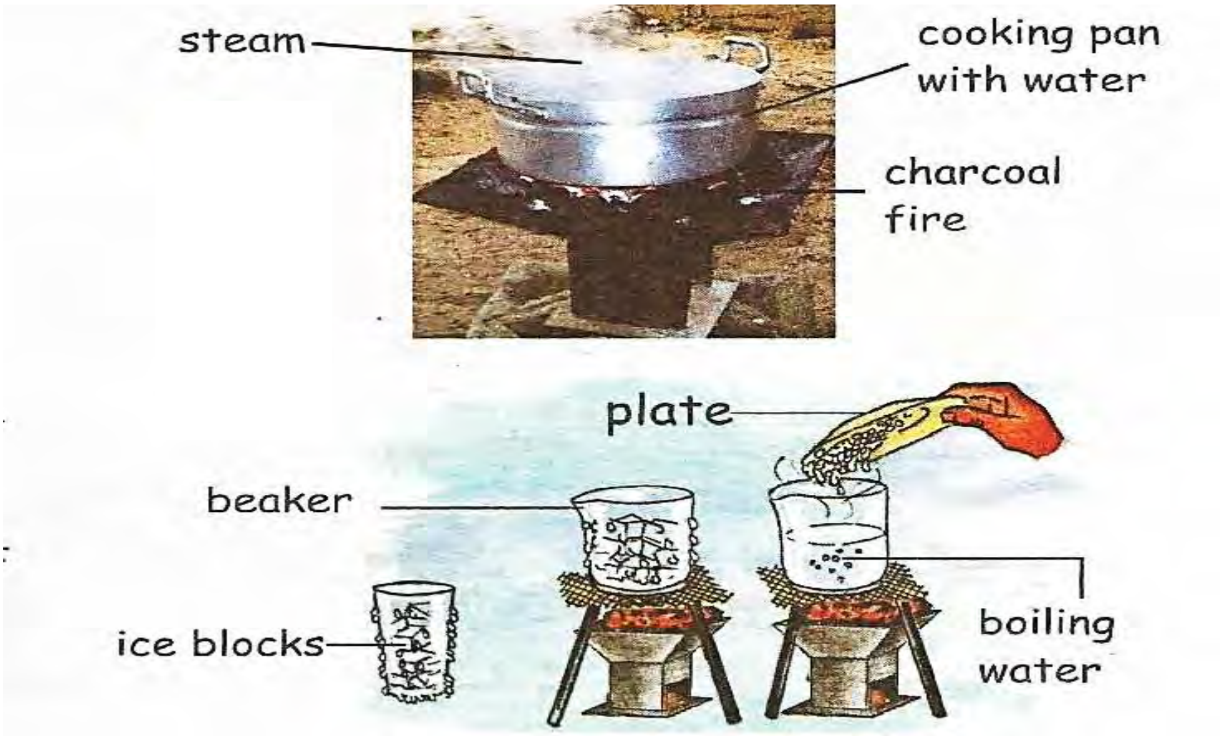


**Fig. 2 Boiling of Water (Change of State of Matter)**

5. Hold the pan's lid across the path of the steam escaping from the liquid.
6. What do you observe?
7. Record your observations and discuss it among the group members.

**ll----Investigating Freezing**

Materials/apparatus-an ice tray or a cup, a freezer and water

**Procedure**

1. Work in groups of four.
2. Pour 500mL of water into the ice tray or cup.
3. Place the tray or cup containing water in freezer for a day.
4. Record what happens and discuss it among the group members.


**Fig. 3 Freezing of Water**

**lll----Investigating Sublimation**

Materials/ apparatus: Ammonium chloride/naphthalene/ sulphur, a beaker, a sheet of glass and a charcoal fire.

**Procedure**

1. Place the ammonium chloride or sulphur in the beaker and cover it with the sheet of glass, as in the picture below.
2. Warm the ammonium chloride or the sulphur or camphor or iodine
3. Record what happens and discuss it among the group members.
4. Discuss the reports presented to the class by the different groups.

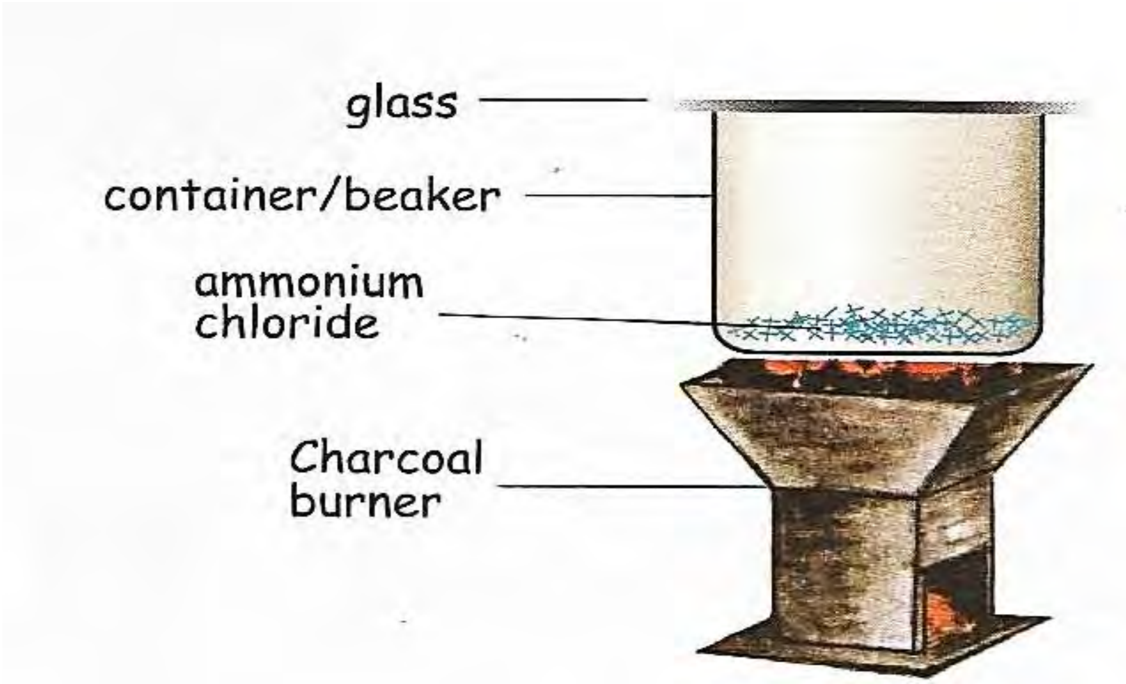


**Fig. 4: Sublimation of Ammonium Chloride/ Naphthalene**

The pupils were assessed after each activity to check their level of understanding

**3.6.3 Mixtures**

**IV**----Preparing different kinds of mixtures

**Materials/Apparatus**

Stirrer, beaker, plastic container, bottle, gari, salt, sugar, palm oil, coconut oil, sand, vegetables, fruits, chalk, bottle of coke or fanta , matches, leaves, paper etc.

1. Work in groups of four.
2. Place 150g each of powdered chalk, sand, salt, sugar and gari in separate beakers or plastic containers.
3. Add 250mL of water , stir and allow to settle as shown in the picture below

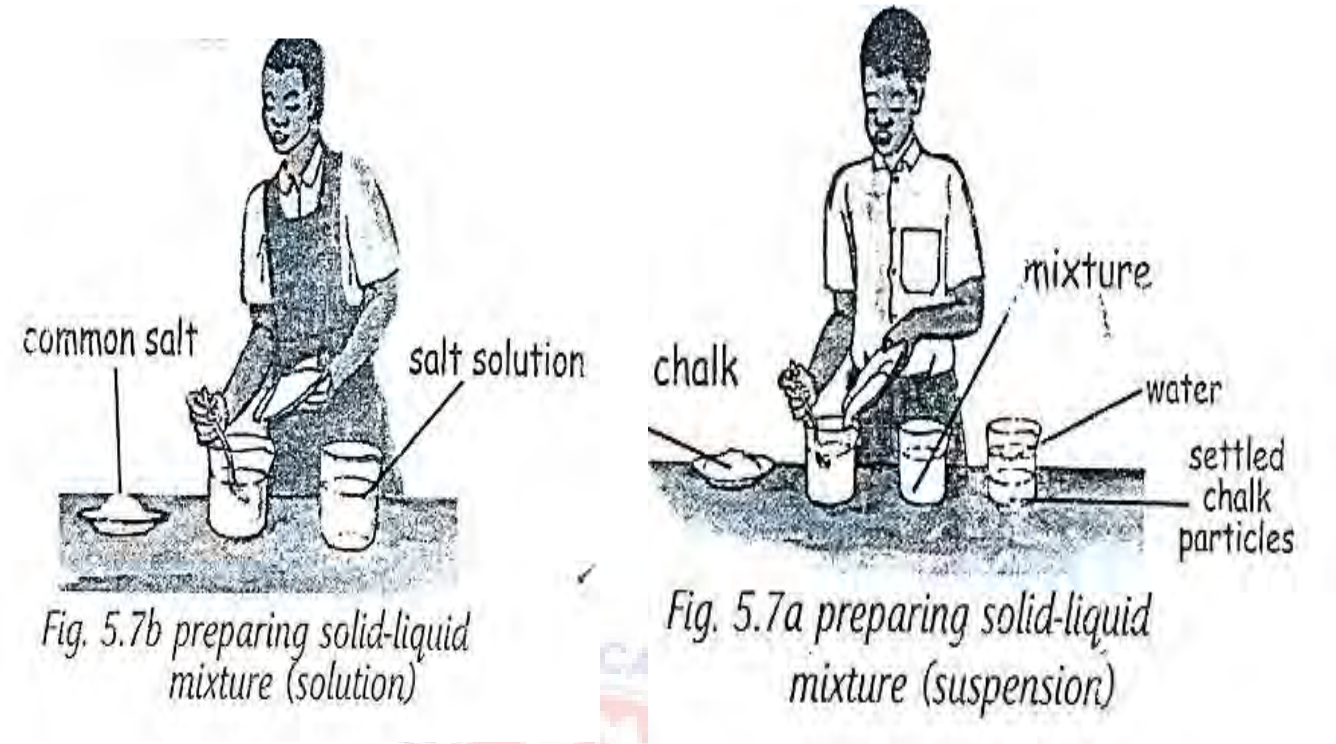


**Fig. 5 Preparing Solid-Liquid Mixture**

**Preparing liquid-liquid mixture**

1. Place 200mL of palm oil or coconut oil in a bottle and add water to it.
2. Shake the bottle and allow it to settle as in the picture below.

**Fig. 6. Liquid- Liquid Mixture**

**Fig. 7 Solid-Solid Mixture**

Cut vegetables separately and mix them together in a bowl.

**Fig. 8 Solid-Solid Mixture**

Cut fruits separately and mix them together in a bowl

**Preparation of a Liquid-Gas Mixture**

Open a bottle of coke and observe what happens.


**Fig. 9 Gas –Liquid Mixture**

**Preparing Different types/kinds of mixtures**

1. Use matches to burn leaves or paper
2. Observe the smoke rising
3. Compare this with smoke from a kitchen, car exhaust, burning refuse or factory chimney.

Smoke from factory chimneys is a solid-gas mixture

Exhaust fume is a gas-gas mixture of steam and carbon dioxide

Smoke from burning refuse is a solid-gas mixture

**Fig. 10 Different types of mixtures**

4. Observe all the mixtures prepared above carefully and write your conclusions.
5. Copy and complete the given chart into your exercise book. Write the types of mixtures you observed in the activities above.

Pupils were assessed after each activity to check their level of understanding

**3.7.4 V----- Methods of Separating Mixtures**

**Magnetization -Separating iron fillings from sand**

**Materials/Apparatus**

Iron fillings and sand, a piece of paper, a bar magnet and a container (or watch glass)

**Procedure**

1. Work in groups of four
2. Place the mixture in the container
3. Wrap one end of the bar magnet with paper and bring it near the mixture as shown in the diagram below.
4. Record what happens
5. Name this method of separating mixtures

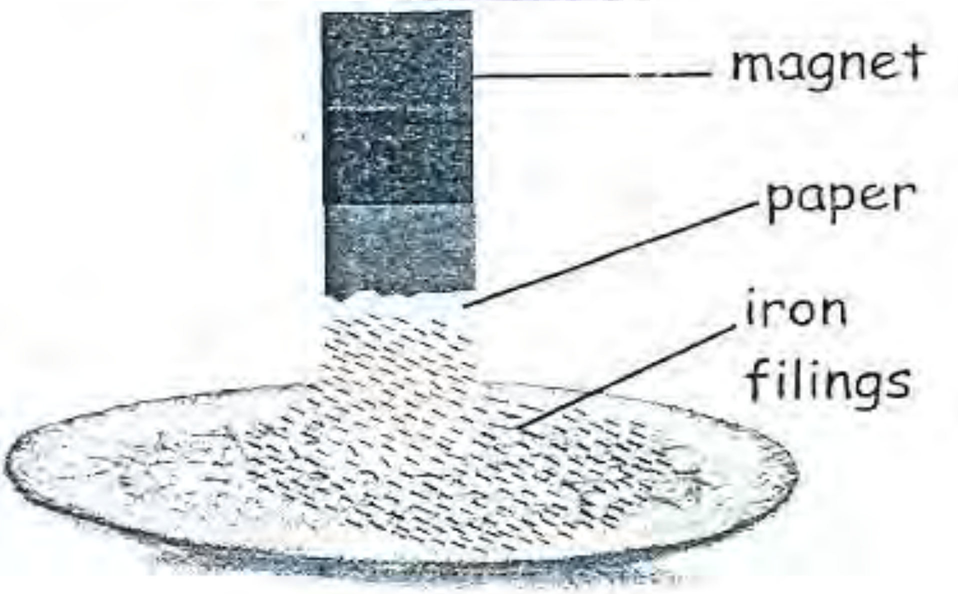


**Fig. 11 Mixture of Sand and Iron Filings**

**Separation of Salt from Water**

**Materials/Apparatus**

A mixture of salt (160g) and water -500mL (salt solution), a beaker for cooking or a cooking pan, a watch glass and a source of heat (Bunsen burner or charcoal fire)

**Procedure**

1. Work in groups of four
2. Pour the mixture on the watch glass, as in Figure 3.12 **A** or in the cooking pan as in picture Figure 3.12 **B**
3. Place the mixture on a water bath as in picture A or on the charcoal fire as in picture B
4. Heat the mixture until all the water has evaporated
5. Record what you observe in the watch glass or in the cooking pan in your exercise book
6. Name this method of separation of mixture

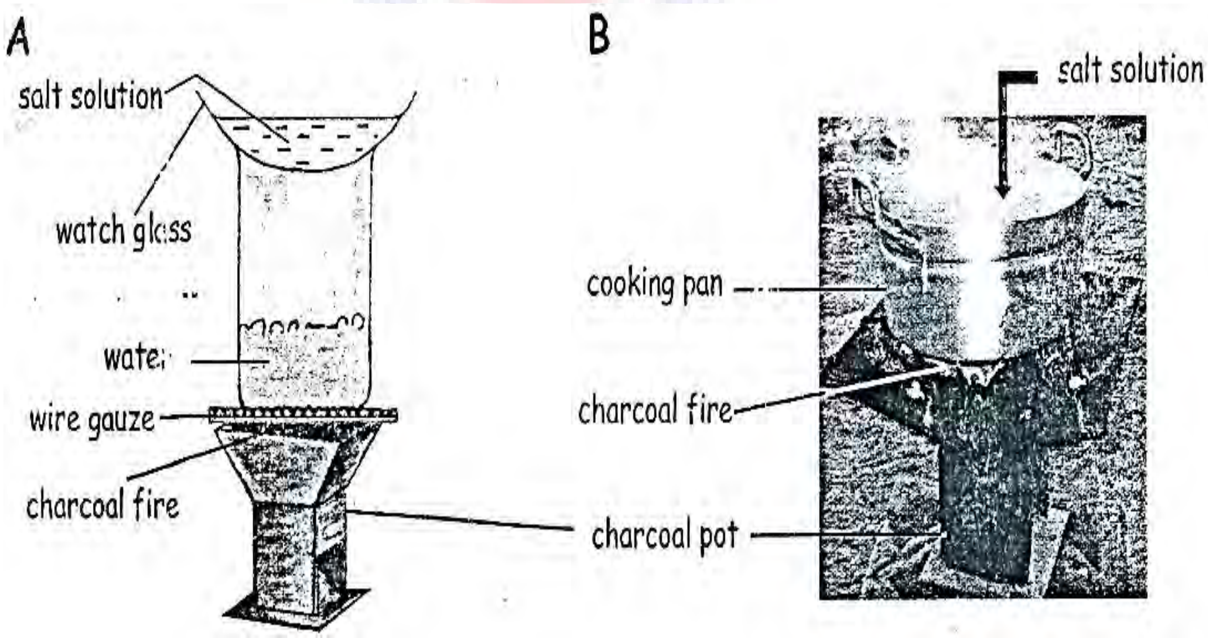


**Fig. 12 Evaporation**

**VI-----Separating Chalk from Water**

**Part A:** Mixture of chalk-100g and water-500mL, a beaker, a bottle, a funnel, a stirrer and a filter paper

1. Work in groups of four
2. Place the filter paper in the funnel and insert it into a bottle as in figure 3.13 **A**
3. Pour the mixture into the beaker
4. Stir the mixture and pour it slowly onto the filter paper as in the figure
5. Allow all the water to drain into the bottle and observe the filter

**Or**

**Part B:** A bottle, a plastic container, a white clothe

1. Work in groups
2. Use the string to tie the clothe over the mouth of the container as in figure 3.13 **B**
3. Pour the mixture into the bottle
4. Shake the bottle and pour the mixture onto the clothe as in figure 3.13 **A**
5. Allow the water to drain into the container and observer the clothe
6. Record what you observe on the filter paper or cloth in your exercise book
7. Give the name of this method of separating mixture

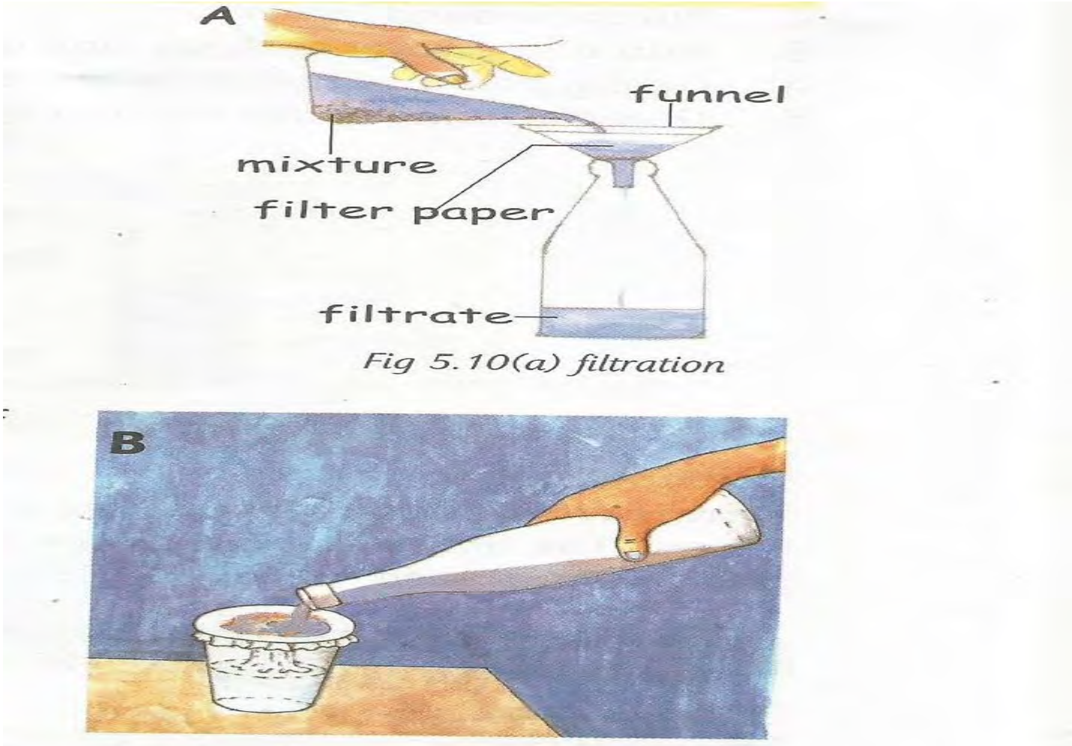


**Fig. 13 Filtration**

**Decantation**

**Separation of sand from water**

**Materials/apparatus:** Sand, cup and water

1. Work in groups of eight
2. Pour 'one American tin' of sand into a cup
3. Add 300g of water to it, stir and allow to settle as shown in figure 3.14 **B**
4. Gently pour the water leaving the sand as in figure 3.14 **C**
5. Discuss and record your observations among the group members.
6. Give the name of this method of separation of mixtures.

Answer exercise 5.2 into your exercise book from Integrated Science for primary schools pupils book five, page 110 (Yeboah, Kwesi-Ahordjie & Mensah, 2012 ).

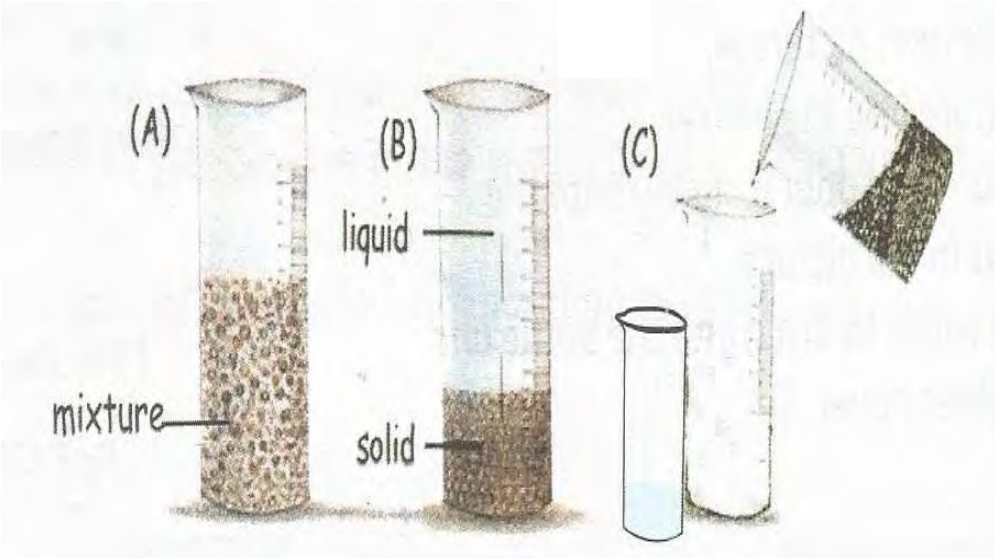


**Fig. 14 Decantation**

**Separation of Chaff from Maize**

**Materials/Apparatus:** Maize or Rice, Two Bowls

1. Work in groups of four
2. Pour 120g of grains into one of the bowls
3. Raise the bowl with the grains and gently pour off the grains into the other bowl as shown in the diagram.
4. Observe what happens to the chaff
5. Record your observations and discuss it with the group members.
6. Name the method used

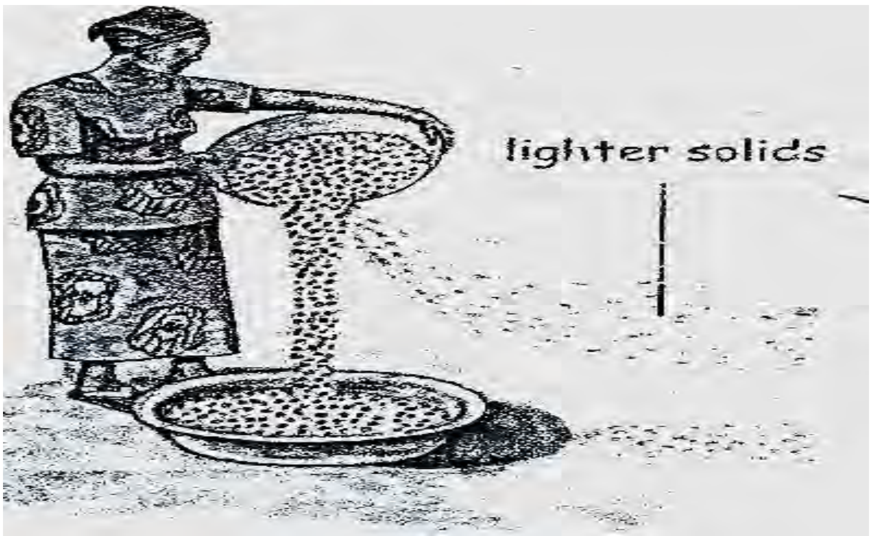


**Fig. 15 Winnowing**

Before the activity lessons, there was an advanced preparation in order to overcome anticipated problems that might be evolved during the actual lesson. The participants were asked to read around the topic mixtures and change of state of matter. The pupils were also involved in the collection of some of the materials to be used during the lesson.

During the first and second activity lessons to teach change of state of matter and mixtures respectively, the lessons were introduced by revising the pupils' previous knowledge. The pupils gave the appropriate responses to the teacher-made questions very well which showed that the previous lessons were successful. The teaching learning materials (TLMs) for each activity such as (transparent plastic cups, stirrer , iron fillings,  sand, chalk , ice water, water , bottles of coca cola, perfume ,sodium chloride, pieces of magnet etc.) were given to the pupils in groups.

Instructions were given to each group on how to perform the activities. The pupils were asked to interact with the materials so that they can find answers to their questions. They were allowed to communicate among their group members and record their observations and findings. The researcher went round to inspect the group work and rewarded groups that were doing well and to encourage the other groups to come up. In another lesson in the third week of the study, the groups were assigned the other three activities (that is Activities IV, V, VI) to perform.  The researcher had a general discussion with the entire class.

### 3.7.5 Post-Intervention Activities

Post-test was conducted to find out if the pupils have overcome their difficulties in the concepts, change of state of matter and mixtures after the implementation of the intervention. The post-test was conducted in the fifth week of the study. The pupils were given a more challenging test items to answer. A more challenging test was given to the pupils.

## 3.8 Reliability of the Main Instrument

Most of the test items were taken from the pupils' text books and terminal examination questions organized by the Municipal Education Directorate. This was to make sure that the questions were not above or below the pupils' level of understanding. The Test-retest reliability was carried out to determine the suitability of the test constructed over time. The correlation coefficient was 0.79. This gave an indication that the test items were reliable. The reliability was obtained by administering the same test twice or more to the same group of students. The results obtained was compared to find out the extent to which the results for the two or more test administered correlated.

## 3.9 Validity of the Main Instruments

According to Joppe (2000), validity determines whether the research instrument truly measures what it was intended to measure. The test item prepared by the researcher was shown to a number of experience teachers including the head of the school and the circuit supervisor who have taught the subject for a very long time. The supervisor of the researcher also gave his input into the test items and made the necessary corrections to make sure that the test items were valid. Based on their critics, the questions were revised in order to achieve the purpose of the study.

### 3.10 Data Analysis

All data collected were screened to check for miscalculations, omitted responses and ensure accuracy. Data collected for answering the research questions were marked, scored, recorded and fed into a computer for analysis with the support of the Statistical Package for the Social Science (SPSS) version 21.0. Frequencies, percentages, means, standard deviations and Related-Samples Wilcoxon Signed Rank. Related-Samples Wilcoxon Signed Rank is a non-parametric statistical hypothesis test used when comparing two related samples, matched samples or repeated measurement on a single sample to assess whether their population mean ranks differ. According to Lowry (2011) Wilcoxon Signed Rank Test can be used as an alternative to the paired student t-test, t-test for dependent samples when the population cannot be assumed to be normally distributed. It is a non-parametric test that can be used to determine whether two dependent samples were selected from population having the same distribution. It is as efficient as the t-test on normal distributions. Wilcoxon Signed Rank statistical tools were used to analyze the data because the sampling technique used was purposive, which is non-parametric method or technique of sampling and hence the appropriate statistical tool to use.

# CHAPTER FOUR

# RESULTS AND DISCUSSION

## 4.0 Overview

This chapter presents the results and discusses the findings of the study obtained through the analysis of data using the Statistical Package for the Social Sciences (SPSS) version 21.0.

## 4.1 Demographic Characteristics of Respondents in the study

**Table 1: Demographic Characteristics of Respondents**

| Demographic | Frequency | Percentage (%) |
|---|---|---|
| **Age** | | |
| 10 | 5 | 7.9 |
| 11 | 9 | 14.3 |
| 12 | 9 | 14.3 |
| 13 | 7 | 11.1 |
| 14 | 14 | 22.2 |
| 15 | 9 | 14.3 |
| 16 | 5 | 7.9 |
| 17 | 5 | 7.9 |
| **Gender** | | |
| **Male** | 40 | 63.5 |
| **Females** | 23 | 36.5 |
| **Total** | **63** | **100** |

Source: Field Data, 2017. Mean Age = 13.40 years, Standard deviation = 20.03, Range 10 – 17 years.

Table 1 shows a summary of the biological data of the participants used in this study. Sixty-three point five (63.5%) of the pupils were males while 36.5% were females. 37% of the pupils were between the ages of ten and twelve years. Majority (63%) of the pupils were between the ages of thirteen and seventeen years. The mean age of the pupils was 13.40 years, standard deviation = 2.03 with a range of 10-17 years. The result signifies that the pupils in primary five in the Effutu Municipal Assembly Primary School were older than the average age (11yers) of pupils expected to be in primary five in Ghana. The results of the study as presented in Table 1 also indicates that there were more males (63.5%) in primary five class of the Effutu Municipal Assembly Primary School than females (36.5%). The results showed that male dominated the females in the two primary five classes in the school.

### 4.2 Analysis and Interpretation of Research Questions

The results of the analyzed data are presented based on the research questions that were posed in chapter.

**4.2.1 Research question one:** What are the pupils' preconceptions of mixtures?

The research question sought to ascertain what the pupils knew already about mixtures, the raw material that would condition the learning of mixtures and how it would act as mental hooks for the lodging of new information (mixtures). It also sought to find the knowledge the learners had that was potentially relevant for acquiring the new knowledge (mixtures).

**Table 2: Pre- intervention Test and Post- intervention test Scores on Mixtures**

| Test score (25 Marks) | Frequency | Percentage (%) |
|---|---|---|
| **Pre- intervention test** | | |
| 0 | 36 | 57.1 |
| 1 | 21 | 33.3 |
| 2 | 5 | 7.9 |
| 3 | 1 | 1.6 |
| **Post- intervention test** | | |
| 5 | 13 | 20.6 |
| 10 | 31 | 49.3 |
| 15 | 13 | 20.6 |
| 20 | 4 | 6.3 |
| 25 | 2 | 3.2 |
| **Total** | **63** | **100** |

**Pre-intervention test -** n = 63. Source: Field Data, 2017. Mean = 0.54, S.D = 0.71, Range = 1.00 – 3.00

**Post-intervention test -** n = 63. Source: Field Data, 2017. Mean = 11.11, S.D = 4.79, Range = 5.00 – 25.00

The research question one was answered with the aid of test items specifically designed for such purpose. A pre-test was carried out to examine the preconceptions of the pupils on mixtures. The results is presented in Table 2. The outcome revealed that, 57.1% of the pupils had no preconceptions of mixtures as indicated by the zero scores in the pre-test before the intervention of the activity method of teaching and learning of science with a mean of = 11.11(S.D = 4.79).

The activity method of teaching and learning of science was used to address the low performance of pupils in mixtures. A post-test was carried out to determine the effect of the intervention on the performance of the pupils in the concepts of mixtures. The result is indicated in Table 2. The outcome showed that 79.4% of the pupils scored between 10 and 25 marks with a mean of 11.11marks, SD = 4.79 and a range of 5-25 marks. The post-test results indicated an improved performance as a result of the intervention.

**4.2.2 Hypothesis One:** There was no significant difference between pre-test and post-test performance of pupils' preconceptions of mixtures.

Related-Samples Wilcoxon signed Rank test (used to analysis the data because the test is non-parametric and samples are related, matched or dependent. Equivalent to paired t-test which is used for parametric test with similar characteristics) was used to determine whether the difference in the mean scores of pre-test and post-test were significant.

**Table 3: Related-Samples Wilcoxon Signed Rank test of Pre- intervention test and Post- intervention test on the Concept of Mixtures**

| Test Statistic | Standard Error | Standardize Test Statistic | Asymptotic sig.* |
|---|---|---|---|
| **2,016.00** | 145.63 | 6.92 | 0.00 |

* Asymptotic sig. < 0.05, n = 63. Source: Field Data, 2017.

The results in Table 3 indicate Test statistic = (2,016.00), Standard Error = (145.63), Standardized test statistic = (6.92), Asymptotic sig/P-value = (0.00) at 0.05 alpha (Asymptotic sig/P-value 0.00 < 0.05), meaning there was a significant difference between pre-test and post- test performance of pupils' preconceptions of mixtures. The hypothesis ($H_0 1$) was not valid and hence was rejected. This means the preconception of the pupils in mixtures changed significantly after the activity method was used in teaching. In order words, the pupils performed better on the Post-test exercise after receiving instructions on the subject matter during the classroom intervention. The understanding of the pupils increased tremendously.

The pupils understood the topic mixtures very well and were able to answer the questions provided at the end of each activity. The series of class assignments, group work, class test, oral presentations given to the pupils in the course of the studies were well attended to. Even the weak pupils participated very well and were able to answer some questions asked in the course of the study. Majority of the pupils who had no idea about mixtures were now given more examples of mixture in their homes, school and around them. The pupils were able to group mixtures under the various types. An inquiry-based science lesson with student-centered teaching method provided the students with the opportunity to ask questions and followed instructions to arrive at new knowledge which gave students in the science class the opportunity to think and reason critically (Khan & Iqbal, 2011). This gives an indication that when activity method is used to teach mixtures you can get more of the pupils to participate and the pupils would get a better understanding of what is been taught.

**4.2.3 Research Question Two:** What are the pupils' preconceptions on change of state of matter?

The research question sought to determine what the pupils knew already about the changes of state of matter, the raw material that would condition the learning of change of state of matter and how it would act as mental hooks for the lodging of new information (change of state of matter). It also sought to find the knowledge the learners had that was potentially relevant for acquiring the new knowledge (change of state of matter).

**Table 4: Pre- intervention Test and Post- intervention test Scores on Change of State of Matte**

| Test score (25 Marks) | Frequency | Percentage (%) |
|---|---|---|
| **Pre- intervention test** | | |
| 0 | 41 | 65.1 |
| 1 | 16 | 25.4 |
| 2 | 6 | 9.5 |
| **Post- intervention test** | | |
| 5 | 19 | 30.2 |
| 10 | 21 | 33.3 |
| 15 | 13 | 20.6 |
| 20 | 9 | 14.3 |
| 25 | 1 | 1.6 |
| **Total** | **63** | **100** |

**Pre-intervention test**- n = 63. Source: Field Data, 2017. Mean = 0.44 marks, S.D = 0.67, Range =0.00 – 2.00

**Post-intervention test**- n = 63. Source: Field Data, 2017. Mean = 11.19 marks, S.D = 5.44, Range = 5.00 – 25.00

The research question two was answered with the help of test items precisely designed for such purpose. To answer research question two, a pre-test exercise of 25marks was carried out to ascertain the preconceptions of the Primary Five pupils on the change of state of matter. The outcome is presented in Table 4. The results indicated that the pupils' marks ranged from Zero mark to two marks with a mean mark of 0.44 and standard deviation of 0.67. Majority (65.2%) of the pupils scored zero marks in the pre-test exercise which indicated that the pupils had limited preconceptions on the change of state of matter.

After the pre-test exercise on the change of state of matter, the intervention of the activity method of teaching and learning of science was implemented. Table 4 illustrates the results of the post-test exercise of 25 marks carried out to improve the performance of the pupils. The results of the post-test exercise showed that more than two thirds of the pupils scored between 10 and 20 (68.2%) marks. The mean mark was 11.19 with a standard deviation of 5.44 and a range of 5 to 25 marks. This means there was an improvement in the performance of change of state of matter.

**Table 5: Results of Related-Samples Wilcoxon Signed Rank test of Pre-intervention test and Post- intervention test on Preconception of Change of State of Matter**

| Test Statistic | Standard Error | Standardized Test Statistic | Asymptotic sig.* |
|---|---|---|---|
| **2,016.00** | 145.59 | 6.92 | 0.00 |

* Asymptotic sig. < 0.05, n = 63. Source: Field Data, 2017.

To answer research question two, the Related-Samples Wilcoxon Signed Rank test was carried out to examine whether the improvement in the preconceptions of the pupils can be attributed to the intervention which is the activity method of teaching.

The results of the study as presented in Table 5 indicates that Test statistic = 2,016.00, Standard Error = 145.59, Standardized test statistic = 6.92, Asymptotic sig. = 0.00 at 0.05 alpha.

The results showed that there was a significant difference between the Pre-test scores and Post-test score at 0.05 alpha levels. The results meant that the preconception of the pupils on change of state of matter improved significantly after the activity method of teaching and learning of science was used. In order words, the pupils performed better on the Post-test exercise after receiving instructions on the subject matter during the classroom intervention. Some preconception such as ice block is water, sulphur vanishes into thin air when heated, water cannot be in all three states were corrected.

The pupils could not group a number of items under the three states of matter. Kind (2004), stated that children think "There are different kinds of stuff: iron, water, wood, meat, stone, sand etc. The following exist in different kinds of physical state: solid, liquid, powder, paste, jelly, slime; paper-like etc. Each kind of stuff has a usual state: iron, solid, water, liquid, sand is powder, etc., but this can sometimes be changed. For example, many stuffs melt if you make them hot enough...and others burn. Any liquid freeze if you make it cold enough. Any solid can be powdered... There is no obvious standard way of changing a powder to a solid. Some solids decompose, i.e. change slowly into some other substances; or mature, i.e. change slowly into some other (useful) substance.

The study also examined the conceptions children aged between 5 and 12 years have about `solid' and `liquid'- children think of like metals and wood as typical solids. To them, substances which are not hard and rigid cannot be solids, so classifying solids which do not "fit" this image is difficult. The study further found out that 50% of 12 and 13 year olds classify non-rigid solids such as dough, sponge, sand and sugar separately from coins, glass or chalk. Water is the standard "liquid" against which other possible liquids compared. Children found out that powders have liquid properties but do not give out a sensation of wetness, so categorize these independently. Children see water as a typical liquid. Stavy and Stachel (1985), once again found out that in general, children classify new liquids more easily than solids, perhaps because liquids are less varied in their physical characteristics.

Most of the pupils could not explain the decrease in water level in a large tank in their homes. Some gave answers like 'my mother has come to fetch some to cook, Kwasi drank some, Mary took some to wash and I don't know where the water went to. A number of researchers such as Russell *et al* (1989 and 1990), supported the above evidence. In the study, children aged 5 - 11 were asked to explain the decrease in water level in a large tank after sunny weather. About 45% focused on the remaining water, seeing no need to explain where the "missing" water had gone. For these children, the matter had simply ceased to exist.

During the preparation of mixtures in one of the activities, the pupils were asked to explain why very clear solutions were obtained whenever salt or sugar was put in water. Most of the pupils said the solute had disappeared. Most of the pupils had no idea where the solute had gone to. Prieto *et al* (1989), reported that 44% of 14 year olds think a solute "disappears" when dissolved, while 23% label the event "it dissolves" with no explanation. After the pupils have been taught using the activity method, the pupils could now use words like- dissolves with clearer understanding.

Other naive ideas most of the pupils had about mixtures were; when mixing solutions a chemical change will always occur to change the solution to another liquid. Kind (2004), reported a confusion of state versus chemical change. The study found out that around 70% of the 14 year olds and over 50% of the16 year olds thought diluting a strong fruit juice drink by adding water was a chemical change. Some pupils were also of the view that when sugar dissolved in water, it has formed a new substance. At the end of the study, the pupils were able to identify soup, stew, cake mixture, coke, spirit, salad dressing, chocolate chip cookie, concrete, air, detergents, gasoline-oil mixtures sprite etc. as mixtures and not compounds.

The intervention that was put in place was able to help the pupils identify all the things around them as matter and were able to group them under the three states of matter correctly. This means that, the preconception the pupils had about the concept change of state of matter before coming into the class to be taught had been corrected.

**4.2.4 Research Question Three:** What was the impact of activity method of teaching on the pupils' conceptual understanding of mixtures and changes of state of matter?

The research question three sought to discover the effect of activity method of teaching and how this method can be used to improve conceptual understanding of mixtures and change of state of matter. Research question three was answered by conducting a pre-test and post-test to determine the impact of activity method of teaching on pupils' conceptual understanding of mixtures and change of state of matter.

**Table 6: Pre- intervention test and Post- intervention test Scores on Pupils' Conceptual Understanding of Mixtures and Change of State of Matter**

| Test score (Marks in %) | Frequency | Percentage (%) |
|---|---|---|
| **Pre-intervention test** | | |
| 5 | 29 | 46.0 |
| 10 | 16 | 25.4 |
| 15 | 10 | 15.9 |
| 20 | 6 | 9.5 |
| 25 | 2 | 3.2 |
| **Post- intervention test** | | |
| 0-25 | 5 | 7.9 |
| 26-50 | 24 | 38.1 |
| 51-75 | 26 | 41.3 |
| 76-100 | 8 | 12.7 |
| **Total** | **63** | **100** |

**Pre-intervention test-** n = 63. Source: Field Data, 2017. Mean = 9.92, S.D = 5.71, Range = 5.00 – 25.00

**Post-intervention test**- n = 63. Source: Field Data, 2017. Mean = 56.11, S.D = 19.72, Range = 10.00 – 95.00

The results indicated in table 6 showed that the pupils scored a mean mark of 9.92 with standard deviation of 5.71. The majority of the pupils (87.3%) scored between five and fifteen percent. This implies that the pupils had very limited knowledge on conceptual understanding of mixtures and change of state of matter.

The intervention of the activity method of teaching science was carried out to improve the performance of the pupils in the knowledge and conceptual understanding of mixtures and change of state of matter. A post-test was also carried out after the intervention to ascertain if the intervention has improved the performance of the pupils' conceptual understanding of mixtures and change of state of matter. The outcome of the post-test is reported in Table 6. The results showed that the pupils had a mean score = 56.11 with standard deviation=19.72.

**Hypothesis two:** There was no significant difference between the academic performance of pupils before (pre- intervention test) and after (post- intervention test) the use of activity method in teaching mixtures and change of state of matter.

Related-Samples Wilcoxon signed Rank test was used to determine whether the difference in the mean scores of pre-test and post-test were significant.

**Table 7: Results of Related-Samples Wilcoxon Signed Rank Test of Pre-intervention test and post- intervention test on Pupils' Conceptual Understanding of Mixtures and Change of state of Matter**

| Test Statistic | Standard Error | Standardized Test Statistic | Asymptotic sig.* |
|---|---|---|---|
| **2,012.00** | 145.92 | 6.92 | 0.00 |

* Asymptotic sig. < 0.05, n = 63. Source: Field Data, 2017.

The results of the study as presented in Table 7 indicate that Test statistic = (2,012.00), Standard Error = (145.92), Standardized test statistic = (6.88), Asymptotic sig. = (0.00) (Asymptotic sig/P-value 0.00 < 0.05), meaning there was a significant difference between pre-test and post- test performance of pupils' conceptual understanding of mixtures and change of state of matter. The hypothesis ($H_0 1$) was not valid and hence was rejected. The results showed that there was a significant difference between the Post-test score and Pre-test score at 0.05 alpha levels. The results meant that, the conceptual understanding of mixtures and change of state of matter of the pupils improved significantly after the activity method of teaching and learning of science intervention was carried out in the classroom. In order words, the pupils performed better on the Post-test exercise after receiving instructions on the subject matter during the classroom intervention.

The results of the study showed that the activity method of teaching science significantly improved the knowledge and understanding of the pupils on the concept of mixtures and change of state of matter. The findings from this study were confirmed by the work of the authors discussed below.

An inquiry-based science lesson with student-centered teaching method provided the students with the opportunity to ask questions and followed instructions to arrive at new knowledge which enabled students in the science class the opportunity to think and reason critically (Khan & Iqbal, 2011).

A study by Iqbal and Tayyaba R. (2014), concluded that activity-based learning and teaching method generates an ideal situation for science teaching especially at Elementary level. The study further went on to explain that in an activity-based teaching methods, learners are involved actively in hands-on -minds on experiences and acquire an opportunity to relate intangible concepts and theories with actual observations. The study again stated that activity based teaching method helps learners to understand the scientific concepts and students' are actively involved in teaching learning process and activities help them in application of scientific knowledge in various real life situations.

The results of the study was also confirmed by the findings of Ergul et al. (2011), who found that a combination of hands-on activities and inquiry science teaching helped improve the attitude of students towards the study of science. The study further stated that the attitude of the students in the experimental group was said to have improved with respect to that of their counterparts in the control group. This was also confirmed by this study. Throughout the study, the researcher observed that the attitudes of the pupils had changed drastically. The participants didn't like science periods and very often than not would dose off during the lesson. But this was not so during the activity lessons. The pupils always looked forward for the lesson and participated fully throughout the lesson. The pupils saw the lessons as very enjoyable. Hodson 1990, stated that hands-on activities were perceived as an enjoyable and effective form of learning of almost all the major U.S. science curriculum reforms of the late 1960s and early 1970s. An online survey of students (n=1,450) reported that in terms of enjoyability of school science activities, the top three were ‘going on a science trip or excursion’ (85%), ‘looking at videos’ (75%) and ‘doing a science experiment in class’ (71%) (Cerini et al, 2003). Confirmation of effective practice in the use of practical work comes from a range of studies. White and Gunstone (1992), indicated that ‘students must manipulate ideas as well as materials in the school laboratory’ (Lunetta et al., 2007). There is an increasing body of research that showed the effectiveness of ‘hands-on’ and ‘brains on’ activities in school science inside and outside the laboratory. In the course of the study, it was absolutely clear that activity method of teaching can be used to improve the academic performance of the pupils when teaching science concepts. This research work has added to the body of knowledge about the effectiveness of using activity method to teach science concepts.

# CHAPTER FIVE

# CONCLUSIONS AND RECOMMENDATIONS

## 5.0 Overview

This chapter presents the key findings, conclusion and recommendations of the study.

## 5.1 Key Findings

The key findings from the study were as follows; the mean values of the pre-test of the pupils' preconception of mixtures was 0.54 and S.D = 0.71 and that of the post-test was 11.1 and S.D = 4.79. This means there was a great improvement in the preconception of pupils' in mixture. In the related – samples Wilcoxon signed rank test, asymptotic sig/P value = 0.00 meaning there was a significant difference in the preconceptions of mixtures of Primary Five pupils and the intervention which was put in place to correct the preconceptions gave the pupils a better understanding of the concept.

Secondly, the mean value of the pre-test of pupil's preconceptions of change of state of matter was 0.44 and S.D = 0.67 and that of post-test was 11.9 which S.D = 5.44. This means there was a progression in the preconception of the pupils in change of state of matter was 9.22 and S.D = 5.71 and that of the post –test was 56.11 with S.D = 19.72. Meaning there was an improvement in the conceptual understanding of pupils in mixtures and state of matter. In the related-samples Wilcoxon signed rank test, asymptotic sig. = 0.00 meaning there was a significant difference in the academic performance in the Primary Five Pupils.

## 5.2 Conclusions

It was concluded that activity method of teaching should be included in the teaching of integrated science concepts at the primary school levels in Effutu Municipality. The introduction of the activity method in teaching the science concepts produced significant improvement in pupils' learning and understanding as compared to the previous terms. The pupils were able to answer science questions very well in their termly exams. Unlike previous terms where pupils skipped a number of questions during their end of term exams, this time they answered most of the questions. In the course of the study, majority of the pupils had no preconceptions of mixture and change of state of matter, however their understanding on mixtures increased significantly after the intervention (activity method of teaching and learning of science). The activity method of teaching science significantly impacted on the performance of the pupils in the conceptual understanding of mixtures and change of state of matter, however, their performance did not significantly improve during the second post-test exercise.

## 5.3 Recommendations

Based on the findings of the study, the following recommendations were made for improving the performance of the pupils in Primary Five of the Effutu Municipal Assembly basic school;

Firstly, the teachers of the Primary Five pupils should adopt the activity method of teaching science to teach the other science concepts since it has been demonstrated in this study to improve the performance of the pupils in mixtures and the change of state of matter.

Lastly, the teachers of the other classes should adopt the activity method for teaching the pupils in science in their respective classes.

### 5.4 Suggestions for Further Study

The following are suggestions for further research:

1. The study should be replicated in the other classes of Effutu Municipal Assembly Primary School to help validate the findings of this study.
2. This study limited its scope to the Pre-test before intervention and post-test after intervention, thus a study should be conducted to include a control group and an experimental group to validate the impact of the activity method of teaching science on the performance of basic school pupils in the Municipality.

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# APPENDIX A

## PRE-INTERVENTION TEST

## EFFUTU MUNICIPAL ASSEMBLY PRIMARY SCHOOL

## INTEGRATED SCIENCE-BASIC FIVE

**Class test**

NAME: DATE:

CLASS:

SEX:

Duration: 30mins

***Answer all questions by choosing the correct answer from the option a-c provided.***

1. When water is cooled below 0˚C, it changes into …………
   a. Ice
   b. Water
   c. Coke
2. Which of the following is an example of a liquid?
   a. Oxygen
   b. Chairs
   c. Oil
3. Substances which have no fixed shape and fixed volume are known as
   a. Solids
   b. Gases
   c. Liquids
4. Matter is anything that has mass and can occupy---------.

   a. Volume

   b. Space

   c. Mass
5. The three states of matter are?
   a. solid, liquid and gas
   b. water, air and gas
   c. liquid, solid and water

6. A bottle of coca- cola is what type of mixture?
   a. Liquid-liquid
   b. Liquid-solid
   c. Liquid –gas
7. A mixture is any substance made up of two or more substances which are -------combined together.
   a. Chemically
   b. Physically
   c. Mentally
8. Which of the following is a method of separating mixtures?
   a. Filtration
   b. Liquid-liquid mixture
   c. Solid-solid mixture
9. -------- is a method used to separate a solid –liquid mixture in which the solid does not dissolve.
   a. Magnetization
   b. Evaporation
   c. Filtration
10. What method of separating mixtures can you use to separate sand and iron filings?
    a. Magnetization
    b. Decantation
    c. Winnowing

# APPENDIX B

## POST-TEST

## EFFUTU MUNICIPAL ASSEMBLY PRIMARY SCHOOL

## INTEGRATED SCIENCE-BASIC FIVE

## OBJECTIVE TEST

NAME: DATE:

CLASS: SEX:

Duration: 30mins

***Answer all questions by choosing the correct answer from the option a-c provided.***

1. Substances like salt and sugar dissolve in water to form ____________
   a. Solution
   b. Suspension
   c. Colloids
2. Sea water is a ____________
   a. Mixture
   b. Gas
   c. Solid
3. Sobolo is an example of what type of mixture?
   a. Liquid-liquid mixture
   b. Gas –gas mixture
   c. Solid- liquid mixture
4. A mixture of sand and iron fillings is a solid-solid mixture which can be separated by what method?
   a. Filtration
   b. Magnetisation
   c. Evaporation
5. Air is a mixture of what?
   a. Gases
   b. Solids
   c. Liquids
6. Ice block is an example of which of the states of matter?
   a. Liquid
   b. Solid
   c. Gas
7. Bubbles formed by boiling water consist of ____________
   a. Water vapour
   b. Smoke

c. L.P.G gas

8. Matter expands when____________because the particles vibrate quickly and increase the space between nearby particles.
   a. Cooled
   b. Broken
   c. Heated
9. ____________ of water vapour happens when the water vapour in air comes in contact with a cool surface.
   a. Condensation
   b. Evaporation
   c. Filtration
10. When water vapour condenses in the air, it is visible as tiny____________
   a. Smoke
   b. Perfume
   c. Water droplets
11. Deposition is changing a ____________ to a solid by cooling.
   a. Gas
   b. Liquid
   c. Solid
12. The process whereby solid ice changes into liquid water when heat is applied is called ____________
   a. Condensation
   b. Deposition
   c. Melting
13. What name is given to the process whereby the application of heat to water causes it to boil and changes into steam (gas)?
   a. Freezing
   b. Condensation
   c. Boling
14. Which one of the following substances is able to sublime?
   a. Water
   b. Air
   c. Sodium chloride
15. We can change matter from one state to another by____________ or cooling.
   a. Heating
   b. Cleaning
   c. Watering
16. Salt solution can be separated by which of the following methods of separating mixtures?
   a. Winnowing
   b. Magnetization
   c. Evaporation

17. Winnowing involves throwing the mixture into the air so that the wind blows away the ____________while the heavier grains fall back down for recovery.
    a. Chaff
    b. Seed
    c. Fruits
18. Which of the following mixtures has very small participles of one substance evenly distributed throughout another substance?
    a. Solution
    b. Suspension
    c. Colloid
19. Which of the following mixtures is a common mixture found in the home?
    a. Soup
    b. Cement
    c. Smoke from factory chimneys
20. Distillate is the liquid collected after ____________
    a. Filtration
    b. Evaporation
    c. Distillation

# APPENDIX C

## TABLE OF SCORES

**PRIMARY FIVE A** | **PRIMARY FIVE B**

| Pre-test | Post-test 1 | Post- test 2 | Pre-test | Post-test 1 | Post- test 2 |
|---|---|---|---|---|---|
| 5 | 20 | 45 | 10 | 75 | 80 |
| 5 | 60 | 50 | 15 | 55 | 75 |
| 5 | 50 | 55 | 10 | 90 | 35 |
| 15 | 25 | 60 | 5 | 40 | 55 |
| 10 | 40 | 80 | 5 | 60 | 70 |
| 20 | 25 | 45 | 5 | 50 | 60 |
| 10 | 25 | 55 | 15 | 50 | 60 |
| 5 | 40 | 35 | 20 | 45 | 70 |
| 5 | 70 | 80 | 5 | 75 | 90 |
| 5 | 35 | 40 | 5 | 30 | 45 |
| 10 | 50 | 65 | 10 | 55 | 85 |
| 5 | 70 | 60 | 20 | 60 | 60 |
| 15 | 75 | 40 | 20 | 70 | 50 |
| 25 | 50 | 75 | 5 | 70 | 50 |
| 15 | 95 | 55 | 5 | 85 | 70 |
| 20 | 75 | 55 | 10 | 70 | 50 |
| 10 | 50 | 90 | 5 | 60 | 60 |
| 20 | 40 | 65 | 15 | 45 | 65 |
| 10 | 30 | 75 | 5 | 65 | 90 |
| 5 | 30 | 45 | 5 | 85 | 50 |
| 5 | 40 | 80 | 10 | 45 | 35 |
| 15 | 70 | 30 | 5 | 60 | 55 |
| 15 | 60 | 80 | 5 | 75 | 60 |
| 10 | 50 | 65 | 5 | 70 | 55 |
| 5 | 85 | 60 | 10 | 95 | 40 |
| 5 | 45 | 60 | 15 | 70 | 70 |
| 5 | 70 | 35 | 10 | 35 | 40 |
| 20 | 60 | 45 | 5 | 30 | 100 |
| 5 | 75 | 80 | 15 | 45 | 60 |
| 10 | 80 | 45 | 10 | 70 | 75 |
| 5 | 50 | 55 | 5 | 85 | 50 |
| | | | 10 | 80 | 55 |
| | | | 5 | 45 | 70 |

# APPENDIX D

## SAMPLE OF PUPILS' RESPONSES TO PRE-TEST ITEMS

**EFFUTU MUNICIPAL ASSEMBLY PRIMARY SCHOOL**

**INTEGRATED SCIENCE-BASIC FIVE**

**Class test**

NAME:

DATE: 20/05/2017

CLASS: 5 A

SEX: F

14/20

Duration: 30mins

*Answer all questions by choosing the correct answer from the option a-c provided.*

1. When water is cooled below 0°c, it changes into …………
   a. Ice
   b. Water
   c. Coke
2. Which of the following is an example of a liquid?
   a. Oxygen
   b. Chairs
   c. Oil
3. Substances which have no fixed shape and fixed volume are known as ………………..
   a. Solids
   b. Gases
   c. Liquids
4. Matter is anything that has mass and can occupy---------.
   a. Volume
   b. Space
   c. Mass
5. The three states of matter are?
   a. solid, liquid and gas
   b. water, air and gas
   c. liquid, solid and water
6. A bottle of coca- cola is what type of mixture?
   a. Liquid-liquid
   b. Liquid-solid
   c. Liquid –gas
7. A mixture is any substance made up of two or more substances which are -------combined together.
   a. Chemically
   b. Physically
   c. Mentally
8. Which of the following is a method of separating mixtures?
   a. Filtration
   b. Liquid-liquid mixture
   c. Solid-solid mixture
9. -------- is a method used to separate a solid –liquid mixture in which the solid does not dissolve.
   a. Magnetization
   b. Evaporation
   c. Filtration
10. What method of separating mixtures can you use to separate sand and iron filings?
    a. Magnetization
    b. Decantation
    c. Winnowing

**Sample of Pupil's Work Continue**

EFFUTU MUNICIPAL ASSEMBLY PRIMARY SCHOOL

INTEGRATED SCIENCE-BASIC FIVE

Class test

NAME: DATE:

CLASS: SEX:

Duration: 30mins

*Answer all questions by choosing the correct answer from the options provided.*

1. When water is cooled below 0°c, it changes into ...........
   a. Ice
   b. Water
   c. Cake
2. Which of the following is an example of a liquid?
   a. Oxygen
   b. Chairs
   c. Oil
3. Substances which have no fixed shape and fixed volume are known as ..................
   a. Solids
   b. Gases
   c. Liquids
4. Matter is anything that has mass and can occupy———
   a. Volume
   b. Space
   c. Mass
5. The three states of matter are?
   a. solid, liquid and gas
   b. water, liquid, gas
   c. liquid, solid and water
6. A bottle of coca-cola is what type of mixture?
   a. Liquid-liquid
   b. Liquid-solid
   c. Liquid –gas
7. A mixture is any substance made up of two or more substances which are ——combined together.
   a. Chemically
   b. Physically
   c. Mentally
8. Which of the following is a method of separating mixtures?
   a. Filtration
   b. Liquid-liquid mixture
   c. Solid-solid mixture
9. ——— is a method used to separate a solid –liquid mixture in which the solid does not dissolve.
   a. Magnetization
   b. Evaporation
   c. Filtration
10. What method of separating mixtures can you use to separate sand and iron filings?
    a. Magnetization
    b. Decantation
    c. Winnowing

**Sample of Pupil's Work Continue**

EFFUTU MUNICIPAL ASSEMBLY PRIMARY SCHOOL

INTEGRATED SCIENCE-BASIC FIVE

Class test

NAME:

DATE: 24/5/2017

CLASS: Five A

SEX: Female

Duration: 30mins

*Answer all questions by choosing the correct answer from the option a-c provided.*

1. When water is cooled below 0°c, it changes into ...........
   a. Ice
   b. Water
   c. Coke
2. Which of the following is an example of a liquid?
   a. Oxygen
   b. Clains
   c. Oil
3. Substances which have no fixed shape and fixed volume are known as ....................
   a. Solids
   b. Gases
   c. Liquids
4. Matter is anything that has mass and can occupy---------
   a. Volume
   b. Space
   c. Mass
5. The three states of matter are?
   a. solid, liquid and gas
   b. water, air and gas
   c. liquid, solid and water
6. A bottle of coca- cola is what type of mixture?
   a. Liquid-liquid
   b. Liquid-solid
   c. Liquid- gas
7. A mixture is any substance made up of two or more substances which are ------combined together.
   a. Chemically
   b. Physically
   c. Mentally
8. Which of the following is a method of separating mixtures?
   a. Filtration
   b. Liquid- liquid mixture
   c. Solid-solid mixture
9. -------- is a method used to separate a solid liquid mixture in which the solid does not dissolve.
   a. Magnetization
   b. Evaporation
   c. Filtration
10. What method of separating mixtures can you use to separate sand and iron filings?
    a. Magnetization
    b. Decantation
    c. Winnowing

**Sample of Pupil's Work Continue**

EFFUTU MUNICIPAL ASSEMBLY PRIMARY SCHOOL

INTEGRATED SCIENCE-BASIC FIVE

Class test

NAME:

DATE: 20/3/19

CLASS: Five B

SEX: Female

Duration: 30mins

***Answer all questions by choosing the correct answer from the option a-c provided.***

1. When water is cooled below 0°c, it changes into ..........
   a. Ice
   b. Water
   c. Coke
2. Which of the following is an example of a liquid?
   a. Oxygen
   b. Chalk
   c. Oil
3. Substances which have no fixed shape and fixed volume are known as ......................
   a. Solids
   b. Gases
   c. Liquids
4. Matter is anything that has mass and can occupy------
   a. Volume
   b. Space
   c. Mass
5. The three states of matter are?
   a. solid, liquid and gas
   b. water, ice and gas
   c. liquid, solid and water
6. A bottle of coca- cola is what type of mixture?
   a. Liquid-liquid
   b. Liquid-solid
   c. Liquid –gas
7. A mixture is any substance made up of two or more substances which are ------combined together.
   a. Chemically
   b. Physically
   c. Mentally
8. Which of the following is a method of separating mixtures?
   a. Filtration
   b. Liquid-liquid mixture
   c. Solid-solid mixture
9. ------- is a method used to separate a solid liquid mixture in which the solid does not dissolve.
   a. Magnetization
   b. Evaporation
   c. Filtration
10. What method of separating mixtures can you use to separate sand and iron filings?
    a. Magnetization
    b. Decantation
    c. Winnowing

**Sample of Pupil's Work Continue**

EFFUTU MUNICIPAL ASSEMBLY PRIMARY SCHOOL

INTEGRATED SCIENCE-BASIC FIVE

Class test

NAME: DATE: 20/05/2017

CLASS: 5B SEX: Male

Duration: 30mins

*Answer all questions by choosing the correct answer from the options provided.*

1. When water is cooled below 0°c, it changes into ............
   a. Ice
   b. Water
   c. Coke
2. Which of the following is an example of a liquid?
   a. Oxygen
   b. Chairs
   c. Oil
3. Substances which have no fixed shape and fixed volume are known as ............
   a. Solids
   b. Gases
   c. Liquids
4. Matter is anything that has mass and can occupy--------.
   a. Volume
   b. Space
   c. Mass
5. The three states of matter are?
   a. solid, liquid and gas
   b. water, air and gas
   c. liquid, solid and water
6. A bottle of coca- cola is what type of mixture?
   a. Liquid-liquid
   b. Liquid-solid
   c. Liquid- gas
7. A mixture is any substance made up of two or more substances which are ------combined together.
   a. Chemically
   b. Physically
   c. Mentally
8. Which of the following is a method of separating mixtures?
   a. Filtration
   b. Liquid-liquid mixture
   c. Solid-solid mixture
9. ------ is a method used to separate a solid – liquid mixture in which the solid does not dissolve.
   a. Magnetization
   b. Evaporation
   c. Filtration
10. What method of separating mixtures can you use to separate sand and iron filings?
    a. Magnetization
    b. Decantation
    c. Winnowing

# APPENDIX E

# INTRODUCTORY LETTER

UNIVERSITY OF EDUCATION, WINNEBA
DEPARTMENT OF SCIENCE EDUCATION
P. O. BOX 25, WINNEBA TEL. NO. 0202041079
Website: www.uew.edu.gh Email: science@uew.edu.gh

Our Ref:

Your Ref: Date: April 01, 2017

TO WHOM IT MAY CONCERN

Dear Sir/Madam,

**LETTER OF INTRODUCTION**
**AMPADU-DAADUAM, RUTH A. (STUDENT INDEX NO. 8150130006)**

We write to introduce the above student who is an M.Phil. student of the Department of Science Education at the University of Education, Winneba. Please, she has requested for an introductory letter to enable her conduct a research on *"Using Activity Method to Improve Basic School Pupils' Performance in selected Concepts in Integrated Science"* at your outfit.

We should be grateful if you could grant her the required assistance.

Thank you for your cooperation.

Yours faithfully,

**VICTOR ANTWI (PhD)**
AG. Head of Department