THE USE OF THE ARTS AS A TOOL FOR TEACHING SCIENCE AT THE OFORIKROM M/A JUNIOR HIGH SCHOOL

BY

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A thesis submitted to the School of Graduate Studies, KNUST in partial fulfillment of the requirements for the degree of

Master of Philosophy in Art Education

Faculty of Art, College of Art and Social Sciences

May, 2011

DECLARATION

I hereby declare that this submission is [illegible]ards the Mphil degree and that to the best of my knowledge, it contains no materials previously published by another person nor material which has been accepted for the award of any other degree of the university, except due acknowledgement has been made in the text.

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ABSTRACT

This research work was an action research carried out based on three focal objectives. These objectives are as follows: 1), to distinguish and to demonstrate the interrelationship between science and art, 2), to develop a strategy for art as an integral element in teaching science and 3), to examine and analyze the use of art as an instrument for teaching science. Qualitative research method was employed to gather extensive data on the use of the arts to teach science at the Oforikrom M/A Junior High School in Kumasi. The researcher adopted the convenience sampling technique for the purpose of selecting the sample for the action research carried out. Interviews, questionnaire and observation methods were the instruments used to gather data. The researcher deliberately controlled and manipulated the conditions which determined the teaching activities and events of direct relevance to the research and to introduce an intervention and also measure the difference that it made. The researcher used art activities in a controlled teaching situation, to teach some topics in one class while normal teaching strategies were adopted in the other class but without art activities. In the end, both classes wrote the same test to enable the researcher check the impact of use of the art in teaching. The hands-on activities which make children remember what they learn were employed in teaching. The study revealed that the intervention lesson which were activity-oriented, hands-on lessons allow children who have difficulty in expressing themselves freely verbally to express and to demonstrate their understanding of the concepts taught. It also revealed that the lecture method of teaching an integrated science lesson at the Junior High School level does not help the children to enjoy and to understand what is taught them. It rather makes lessons dull, boring and puts children to sleep. It is recommended that teachers

should vary their methods of teaching integrated science and adopt more child- centered lessons such as hands-on activities and visually oriented materials to ensure that their students' different abilities are catered for. It is also recommended that Science Resource Centres as well as Art and Science Museums should be provided at the basic levels of education in the various sub-metro and district offices of education in Ghana to make children develop interest in science at an early age.

ACKNOWLEDGEMENTS

There is a season for everything under the sun and one can only be appreciative of the good things that come our way. To this, I express my heartfelt thanks to my Supervisor Dr. Mariama Ross for her good sense of direction, her constructive criticism and supervision to ensure that this research work was completed and submitted on schedule.

To Mr. Sampong Sasu, for his support and advice I am grateful. And to Dr E.C. Nyarkoh, Dr. Joseph Adu-Agyem, Dr.S.K. Amenuke, Nana Afia Opoku-Asare, to all and sundry who have helped in diverse ways to make this research work a success.

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CHAPTER ONE

INTRODUCTION

1.1 Overview

This chapter is the introductory part to the study and it entails the background to the study, statement of the problem, objectives of the study, research questions, delimitations, limitations, importance of the study and the organization of the rest of text.

1.2 Background to the Study

Oforikrom is located in the Kumasi Metropolis with a population of about five thousand. The residents are mainly carpenters. Majority of the school children are from the community and are made up of house helps and apprentices who have little or no time for studies after school. Most of these children have reading difficulties and this might probably be due to the fact that they do not get ample time to read other books.

The nature of science at Junior High School is very compact and demanding in the sense that it requires a lot of reading, experimentation and also drawing skills. However, the place and role of art in the school curricula is seen as trivial and not as a subject most sought after. It was only in the year 2008 that the school curriculum introduced visual art as a subject at the Junior High School level. It is known that art plays a pivotal role as far as the teaching and learning of science at the Junior High School level is concerned. Perhaps, it is in this light that Glover (1977:P.9) says that "there is no single subject in the school curriculum that teaches a unique thing that other subjects do not touch on".

The following is a list of specific science topics in the Junior High School syllabus which can be taught with the help of the arts: matter, cells, the structure of a fish, the human respiratory system, the circulatory system in humans, machines, the moon and eclipse, ecosystems, structure of atoms, the human reproductive system, diffusion and osmosis, the solar system, digestion in animals etc.

It is probably true to say that no science teacher has ever been to space yet they confidently employ the arts to teach about the solar system. Also, the structure of an atom or the formation of ions seems very distant, weird, too theoretical and confusing without the use of art such as drawings and models in teaching these topics to young people. Also, the emphasis on a passing grade in science and other core subjects as a prerequisite for entry into Senior High School makes students as well as teachers relegate the “art” factor to the background.

1.3 Statement of the Problem

The teaching of science is made more effective when there is the use of real objects, role play, improvisation or illustrations (or teaching and learning materials) which are all forms of the arts. To this effect, most children with reading difficulties might see some lessons in science as boring and ambiguous. This notwithstanding, the subject might seem abstract and without real objects or materials the lesson might even be absurd and seemingly difficult. The skill in art which can probably be employed in a case such as this to bring the message home is alienated from science. Research has proven that the visual language which is better understood by literates, semi-literates and illiterates alike if estranged from the science, makes it difficult for children to understand.

There is a false notion that science is a difficult subject and as such it is the preserve of the academically inclined therefore art is for the less brilliant ones. Some parents even get angry at their children who make claims to be keenly interested in art for reasons best known to themselves. People are entitled to their opinions. However, the interrelationship of the two disciplines cannot be overemphasized.

Some pupils also see both art and science as relatively demanding and expensive subjects of study in school. There may be inadequate quality materials to teach these subjects effectively at the basic level. Most schools all over the country will testify that there are no laboratories for experiments or art studios for practice. The few science resource centers are ill-equipped and sometimes so distant from the various basic schools that they are impractical to access them.

These problems mentioned above call for research that focus on integrating art in the teaching of science to make the science subject more realistic and understandable to students.

1.4 Objectives of the Study

The objectives of this study are:

1. To make students demonstrate the interrelationship between science and art.

2. To develop a strategy for the arts as an integral element in teaching science.

3. To examine and analyze the effects of the use of the arts as an instrument for teaching science.

1.5 Research Questions

To act as a guide to this research work the following research questions were formulated.

1. What is the correlation between art and science?

2. What strategies should be devised to integrate art in the teaching of science?

3. How effective is the use of the arts as an instrument in teaching science at the Junior High School?

Delimitation

This project is an action research which is limited to the teaching of science in the Oforikrom M/A Junior High School in Kumasi and a sample of pupils in Forms One and Two classes.

1.7 Limitations

The research focused on four classes of the Oforikrom M/A Junior High School. However, the usual school routines and programmes interrupted the researcher's work. In addition, a two week nationwide teacher strike action further disturbed proper interaction with Form two students and supervision of research work by the researcher.

1.8 Importance of the Study

The study provides useful data to both science and non-science teachers, students in the Oforikrom M/A Block "A" in particular and generally in Ghana on how the arts help to lessen the burden of ambiguity in science teaching.

The study seeks to also enlighten society on the pivotal role art plays in the teaching of science so as to make society eschew negative perceptions associated with the art. Also the study provides constructive means of giving the classroom teacher the impetus for integrating the art in effective teaching. It also highlights the integration and correlation of art and science for further research in curriculum development in Ghana.

1.9 Organization of the Rest of the Text

This thesis has been organized into five chapters. Chapter One which is also known as the Chapter Two is the review of available literature on the use of arts to teach science. Chapter Three entails the research methodology while Chapter Four deals with the analysis and interpretation of the main findings field work. Chapter Five provides the summary, conclusions and recommendations of the study.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Overview

This review of related literature brings out existing knowledge about the relationship between art and science. There is a fundamental relationship between the two disciplines of art and science as in the problem of how art can be used as a tool for teaching science at the Junior High School level of the Ghanaian educational ladder.

The topics reviewed were as follows:

Teaching of science at the Junior High School

Tools for teaching science

The art of teaching and learning

The use of the arts in teaching

The interrelationship between art and science

Interdisciplinary curriculum

2.2 Teaching of Science at the Junior High School

Science is one of the core subjects which pupils at the Junior High School in Ghana have to pass before they gain admission into the Senior High School. This makes the subject very crucial and most sought after. Science teaching at the basic School level consists of a combination of physics, chemistry, biology, health science and agricultural science into a subject which is known as Integrated Science. The teaching of this composite subject therefore has to be made as meaningful as possible to students.

The first reference material in the teaching of any course is the teaching syllabus which makes the teacher aware of the scope of the course content. According to Wiredu (2008), modern life requires general specific literacy (for every Ghanaian citizen) which is expected to result in the creation of a scientific culture which is the antithesis to superstition and then to serve as a catalyst that is to help us towards faster development. He further explains that the focus of the study of science at the Junior High School level is the understanding the natural world with the aims of inculcating science literacy so that people can make informed choices in their personal lives and to approach challenges in a systematic and logical order.

Secondly, Wiredu sees the purpose of the study of science as a means to produce competent professionals in the various scientific disciplines who can carry out research and development at the highest level. Wiredu therefore buttresses the point that for a more meaningful education to take place, it is important for pupils to be trained in the investigative process of seeking answers to questions. To him, although the content of the syllabus is organized into five themes, the units under each theme are not to be viewed as separate blocks of knowledge. He therefore suggests that teachers make use of use of diagrams, charts, making of models and drawings in order to make the topics meaningful to the students.

Wiredu further instructs that sketches could be made to show the arrangement of particles in solids, liquids and gases; models and charts could be used to teach plant and animal cells; charts and digital content should be used to identify and discuss the major parts of a fish; and for discussion of the types of respiration. Also, he insists on the drawing of the structure of an atom and the drawing of the distribution of electrons in atoms of the first twenty elements on the periodic table.

Einstein as cited in the Visual Encyclopedia of Science (1994) says that the whole Science is nothing more than a refinement (improvement) of everyday thinking and that because science is an integral part of education every effort should be made to enhance its learning and understanding. This statement views science as part of our very existence and therefore every effort should be made at making its learning worthwhile.

On the other hand, another school of thought has it that the science programme may only give students abstract scientific ideas which may not apply to everyday situations. For instance, Kesidou and Roseman (2005) argue that school science programmes only seldom provide students with a sense of purpose for the units of study or take accounts of student beliefs that interfere with learning or even engage students with relevant phenomena to make abstract scientific ideas plausible, let alone model the use of scientific knowledge so that students can apply what they learned in everyday situations. Kesidou and Roseman do not seem to see how to marry the seeming absurdity of scientific ideas into concrete and applicable situations hence this idea.

2.3 Tools for teaching science

According to www.blog.montessorifeveryone.com/science, the two best tools for teaching sciences are *language* and *experiments*. Language is intangible whereas experiments may be both concrete and intangible. It further explains that the language of science is not of the same meaning as words used in everyday life. Thus, there is a school of thought that the terms or words in English language are so familiar and frequently invoked that the student has lost all sense of the fact that he or she does not really know what they mean. Unfortunately, teachers sometimes assume that the students already know the scientific meaning of the terms they use in teaching because they know its everyday meaning. When studying science, we take the same words that we use in daily life and give them a greatly modified and specific scientific meaning. However, this new meaning is only vaguely connected to their normal usage. Examples of such words include *force, weight, mass, acceleration,* and *energy*.

In addition, www.blog.montessorifeveryone.com/science explains that experiments chosen make the lesson ambiguous or clear to the learner. This may be due to the fact that sometimes teachers are tempted to do the most dramatic experiments and demonstrations in the name of fun or getting learners interested in science. However, even if the teachers give a truthful explanation for the idea they may be illustrating, the students may abandon their words for the sake of their own form of logic if their minds are not ready for it. For instance, if one is talking about gravity, one might drop a rock and a feather at the same time to observe the fascinating difference in the way they fall to the ground. Because the feather takes longer to reach the ground for the reason that it is lighter, the casual observer (the students and maybe some adults too) might conclude that lighter or smaller objects fall at a slower rate than heavy ones. Perhaps, it does not matter if the teacher carefully explains that the reason the feather takes longer to reach the ground is because of air resistance. The ultimate goal here is that the image of the rock hitting the ground almost instantly while the feather wistfully takes its time will engrave itself in the child's mind. Again, Pea (as cited in Dickinson, 1997) states that intelligence does not lie just in the minds of individuals but it exists in our interaction with other people; in the resources in our environment such as books and other published materials, radio and television, art exhibits, concerts, and plays; and it exists and grows through the tools we use such as hammers and chisels, pens and paper, word processors and calculators, computers, paint brushes and musical instruments. He strongly thinks that our productive activities change the world, thereby changing the ways in which the world can change us. By shaping nature and how our interactions with it are mediated, we change ourselves. Thus our actions result in equal reaction and it epitomizes our inborn abilities to create. There is therefore the need for teachers to use the arts as tools to reinforce students' concrete experiences with scientific phenomena.

Again Clinton (as cited in Cornett, 2003:P.73) also adds that "The spirit of Creative America has spurred us to say and write and draw what we think, feel and dream… to celebrate through dance, in songs, in paint and on paper". Probably that is to say that the spirit of creativity lingers on and stimulates the arts. Therefore, the ability to create and to train the mind in abstract thoughts is motivated by artistic tools such as performing art, literature, writing and drawing.

The Visual Encyclopedia of Science (1994) has it that each important topic is explained with carefully prepared text supported and expanded by highly visual techniques such as the numerous illustrations, photographs, maps, tables, charts and fact boxes with the principal aim of exciting the mind about science. Hassard (2004) rather emphasizes a humanistic, experiential, and constructivist approach to teaching and learning through integrating a wide variety of pedagogical learning tools which involve inquiry, experimentation, reflection, writing, discussion, and interaction. The author explains that the experiential tools make it useful for both pre- and in-service teacher education environments and are easily adapted to any classroom setting. He therefore sees the need for preparing science teachers as professional artists to enhance classroom performance. Gude (2003) states that when art teachers help students learn to interpret and analyze the way in which visual and material culture shapes the world around them, they are not inappropriately contaminating an otherwise pure experience of childhood, they are offering students important tools to make sense of, to enjoy, and ultimately to shape the world. Again,

Gude(2003:P.23) argues that

> Kindergarten through college, art students should be given multiple opportunies to make personal meaning through the sensuous exploration of materials whether these materials are watercolors, clay, electronic pixels, or appropriated images. Good art teachers at all grade levels help students to increase their capacities to understand and communicate by drawing students' attention to concepts and vocabulary that will increase their awareness of art and of the world around them.

Cornett (2003) says that art is a way of communicating through visual and spatial symbols. Arnheim (as cited in Cornett, 2003) says that the most fundamental fact to be understood about art is that whatever it shows is presented as a symbol or images point to the nature of the human condition. It is obvious that these authors share the opinion that art is a very important key to opening academic or other scholarly doors through effective communication with symbols and images without which learning would be an arduous task and very frustrating.

Dickinson (2006) is of a divergent opinion and says that the arts are languages that most people speak and it cuts through individual differences in culture, educational background, and ability, thus believes making the arts a focal point is very crucial to education. In addition he believes that learning through the arts can bring every subject to life and turn abstractions (no matter how ambiguous) into concrete reality that often results in greater academic achievement and higher test scores.

According to Cornett (2003:P.7), the arts open avenues for understanding and expression by drawing us into shared views of others and that childhood experiences build the brain's circuit in all academic fields. Murfee (as cited in Cornett, 2003) contends that "there is mounting evidence linking the arts to basic learning". Cornett says that there is a growing number of elementary and middle classroom teachers using the arts to influence their teaching as the arts are infused into science, social studies and mathematics with energy and relevance. She further argues that children who have the chance to explore with chalk, paints, collage materials, and clay learn to take risks, experiment, explore and problem solve.

Goodwin (as cited by Stephens and Walkup, 2001:P.127) thinks that "all our efforts at educational reform will be futile unless a commitment to effective, efficient, and relevant advocacy or backing for the arts". This perhaps is empirically true to say that the arts are basic to education. Ricouer (as cited in Dickinson, 1997) says the arts offer us models for the redescription of the world. This is because they attach us to others, to our history, and to ourselves by providing a tapestry rich with threads of time, place, character, and even advice on what we might do with our lives. Images of classroom practice ensures that the arts are taken seriously as modes of learning and methods of teaching cut across grade level and subject matter.

Fowler (1991) says that the arts are acts of intelligence and are forms of thought every bit as potent as mathematical and scientific symbols in what they convey. For instance, the Egyptian pyramids can be described in mathematical measurements, and science and history can hypothesize about how, why, and when they were built, but a photograph or painting of them can show us other equally important aspects of their reality. Therefore, it can be seen that the arts were invented to enable us to react to the world at large and to analyze it, and to record our impressions so that they can be shared. Like other symbol systems, the arts require study before they can be fully understood.

2.4 The art of teaching and learning

The art of teaching is the way of rendering teaching which is backed by a skill. The art of doing something is the skill one needs to do that thing effectively or correctly. In a classroom situation, the teacher should be knowledgeable enough to be able to deliver successfully and efficiently for the benefit of learners. Generally, the teacher decides the direction in which his learners have to go.

There is a school of thought that humans are different in many ways in that ability levels to do things (such as learning) vary from one person to another. Cornett (2003) makes a strong statement about the Multiple Intelligences Theory of Howard Gardener which views the arts as distinct modes of thinking under the umbrella of his eight intelligences as verbal/words, visual/art, music, inter/group, intra/individual, logic/math, kinesthetic/drama/dance and naturalistic. Gardener defines intelligence as the capacity to solve problems and create products that would be valued in a cultural setting. Gardener, therefore, grouped four of the eight intelligences (verbal, visual/spatial, musical, and body/kinesthetic) are parallel to the arts domains in literature (verbal linguistic), visual art, music, dance and drama (body/kinesthetic). The other four are linked: logical, interpersonal and intrapersonal are necessary for working with people, and doing self-examination. He posits that we all have capacities in all eight domains but strengths in certain ones and that it is an educational malpractice to teach mainly to and through only verbal and logic intelligences. Gardener therefore urges teachers to draw on students stronger intelligences as vehicles (tools) for working in less brilliant areas.

According to http://en.wikipedia.org/wiki/Bloom%27s_Taxanomy Benjamin Bloom who propounded the Bloom's Taxonomy of cognitive domain explains that, there are six levels within the cognitive domain, from the simple recall or recognition of facts, as the lowest level, through increasingly more complex and abstract mental level, to the highest order which is classified as evaluation. Bloom describes the six levels that represent intellectual activity as knowledge, comprehension, application, analysis, synthesis and evaluation. Bloom's intent was to develop a classification framework for writing educational objectives. The Taxonomy of educational objectives is useful to teachers in teaching and learning because it serves as a tool to facilitate appropriate questioning. Science teachers who employ the use of simple recall only may tend to teach student to produce surface value information and it is a disservice.

According to www.blog.montessorifeveryone.com/science, students do not know about the shift in meaning from English to the science language unless teachers point it out explicitly many times. It is the responsibility of the teacher to endeavour to remind students that even though the words remain the same, they have taken on new scientific meanings that differentiate them from the usual meanings of the words they are used to hearing and saying.

Hassard (2004) affirms that becoming a science teacher is a creative process, and encourages students to construct ideas about science teaching through their interactions with peers, professionals, and instructors, and through hands-on, minds-on activities designed to foster a collaborative, thoughtful learning environment. To him, insightful changes in our understanding of the goals of science teaching-as evidenced by the emphasis on inquiry-based activities advocated by the National Science Education Standards of USA-underscore the need to equip a new cadre of educators with the proper tools to encourage innovation and science literacy in the classroom.

Palmer (1998) is of the view that genuine teaching comes from the heart and reflects the inner work of a lifetime. It emerges from one's inwardness. Good teaching cannot be reduced to technique alone; good teaching comes from the identity and integrity of the teacher. When we learn more about who we are, we can learn techniques that reveal rather than conceal the personhood from which good teaching comes. Again, Calloway-Graham (as cited in Palmer, 1998) says that teaching, like any truly human activity, emerges from one's inwardness, for better or worse. As teaching goes on, the condition of the soul must be projected onto students, in a way of being together. The entanglements experienced in the classroom are often no more or less than the convolutions of one's inner life. Viewed from this angle, teaching holds a mirror to the soul. Notwithstanding this however, Bonk and Cunningham (as cited in Matuga, 2001) see the role of the teacher in the sociocultural view of learning as not to transfer knowledge to students but to construct social opportunities for students to engage in dialogue and authentic tasks leading to participation in a community of practice.

Anderson (2002) is of the view that teachers focus on what works in terms of student involvement or classroom management, rather than on melding theory and practice. As a result the teacher's role in the classroom, students' role in learning, and the nature of student work have all been established as important in the process of teachers acquiring a new approach to teaching.

Matuga, (2001) is of the opinion that the curricula content of an on-line course can be explored from two perspectives and that is the teacher's and that of the students. Both Anderson and Matuga seem to suggest that teaching and learning has everything to do with teachers and students.

According to Eisner (2004), one of the important tasks of teaching is to be able to focus on the individual while attending to the larger classroom patterns of which the individual is a part. The good teacher, like the good short order cook, has to pay attention to several operations concurrently, and they do. The learner on the other hand can only be as good or bad as his teacher. Perhaps it is in this light that Rautkorpi (2007) refers to a Greek mythological figure, Ulysses (Juusela, Lillia and Rinne 2000:P.233) in which the story describes the Greek belief that the relationship between a young person and his or her senior (teacher) relies on "the fundamental principle of human survival". It is obvious that we learn skills, customs and values directly from a person that we look up to and respect. This means that just as a good teacher can impact positively on his students, a bad teacher does exactly the opposite. It is a fact that teaching habits cause students to know what to expect. However, there is another school of thought that "it seems only logical that encouraging [children to be] explorers and questioners than passive acceptors cannot help honing creativity, thinking and learning" (Starko, 1995 as cited in Cornnet 2003, p.48).

Eisner refers to a good teacher as somebody who has proper class control and at the same time offers individual attention while Rautkorpi (2007) sees both the positive and negative impact on the part of the teacher on the learners under him. However, Starko (1995) does not seem to agree to spoon-feeding learners with what they ought to know because he is of the view that the practice does not make room for creative skills development. Eisner (2004) further argues that the distinctive forms of thinking needed to create artistically crafted work relevant not only to what students do but to virtually all aspects of what we do, from design of curricula to the practice of teaching, to the features of the environment in which students and teachers live.

Barbosa, Coutinho and Sales (2005:P.243), after investigating "the key areas of professional development of art teachers and the role of educational resources" also say that there was a feeling that the materials (for teaching and learning) and meeting with teacher groups were interrelated. This is as a result of the fact that teachers were given guidelines at meeting on how to use the teaching and learning materials. Methodologies and knowledge of the appropriate application of allowed the teacher to use the teaching and learning materials in an individual way which is verified through practice.

Consequently, the improper use teaching and learning materials by teachers make them useless.

Kesidou and Roseman (2005) also juxtapose two schools of thoughts. Firstly, there is the view that curriculum materials need to prescribe to teachers exactly what to do, when to do it, and in what order (what was once called teacher-proof curriculum). Secondly, there is the view that curriculum materials are not needed at all, and the teacher must develop his or her own materials because he or she is the only one who knows the particular students' learning needs well enough to modify the classroom environment in response to these needs. Kesidou and Roseman are therefore of the view that key ideas are generally presented in science programmes but then they are typically buried detailed or unrelated ideas and that how well a middle school programme or syllabus supports the attainment of key scientific ideas specified in the national science standard is also important.

Barbosa, Coutinho and Sales as well as Kesidou and Roseman suggest that teaching learning materials or educational resources have a lot to offer education but this notwithstanding; there is the need to match them with appropriate methodology in the classroom situation.

According to Cornett (2003), the arts are ways to create meaning about our deepest feelings and most significant thoughts. She further highlights the importance of teaching and expresses that students need real-life reasons for what their teachers teach them in order that their motivation to learn would be activated. In this way the students are more likely to feel there is purpose to learning. Oddleifson (1995), also has it that to learn because you have to is one thing but to learn because you want to is quite another thing.

And that school is a place a very young child enters with awe, curiosities, expectations, questions, and the desire to feel competent and recognized, and that young child should have those personal characteristics when he or she finishes formal schooling. The arts should be used to create friendly classroom environments to bring all subjects at basic level of education to life.

Zull (2005) on the other hand thinks there is a broader concept of art in terms of having mastery of doing some things. He is of the opinion that we all have our "art" be it the painter with a brush, a successful businessman, a mother comforting her crying child or the paper-boy distributing the morning paper on each doorstep, whatever we have mastered in our life can be considered our "art." Zull explains that a person is said to have mastered an art when he succeeds but cannot say how. To him, wonderful things happen but no one is able to dissect the steps or write out the formula for success. It is just an art!

Dickinson (2006) emphasizes on individual differences as he sees children with different kinds of abilities and disabilities are in the same classrooms. Moreover, children from disadvantaged families learn together with more economically privileged students. To Dickinson therefore, school systems that rely on teaching primarily through the spoken and written word simply do not reach all these kinds of students. He sees the uniqueness of each individual and that even students with similar backgrounds perceive and process information differently.

2.5 The use of the arts in teaching

Art has been employed to make teaching effective and meaningful in a lot of ways. The various aspects of art are used differently to teach to explore and to enhance an expected result in the teaching of various subjects or themes such as academic, religious, historic, cultural informative or expressive. A work of art from any culture and time period can be studied through an examination of universal concepts, themes and real issues to recognize and celebrate cultural diversities.

2.5.1 Academic Purpose

Oddleifson (1997) has it that the arts provide necessary "tools" for thinking which are unavailable elsewhere. Coupled with this, in understanding that a quality education requires bringing heart and hand into balance with head, we quickly conclude that high educational standards simply cannot be met by most children without the arts.

Grimshaw (1996) strongly believes that one of the first creative things a child does is pick up a crayon or pen and scribble. In this way the child expresses himself or herself. Dewey, (as cited in Eisner 2004) says that art has been the means of keeping alive the sense of purposes that outrun evidence and of meanings that transcend indurate habit because to him imagination as a chief instrument in art can be explored to help us restore purpose to our efforts and help to create the kind of schools children deserve.

Fowler (1991) argues that there is the need to provide the fuel that will ignite the mind, spark the aspirations, and illuminate the total being. The arts can often serve as that fuel in the sense that they are the ways through which we apply our imagination, thought, and feeling through a range of "languages" to illuminate life in all its mystery, misery, delight, pity, and wonder. However, Goodlad (as cited in Cornett 2003) believes that the arts are not an educational opinion; they are basic. Stephens and

Walkup (2001) allude to the fact that educational approaches maintain art as central to the curriculum, and a bridge that unites content areas in logical and meaningful ways.

According to Wiredu, Ansong-Ntiri, Darko, Doku, Pomary (2005), most prey animal have adaptations or protective mechanisms that help them to avoid predators. Some animals are camouflaged in the sense that their body colour blend or match the colour of the environment to make difficult for predators to see and catch them. "For example, a green snake hides in green grass or green leaves. Some animals such as the stick insect imitate objects sticks, to avoid predators" (p.106)

Again, Stephens and Walkup say that in the USA the National Content Standard for other subjects, such as language arts, mathematics, performing arts, science and social studies correlated with the arts. For instance, in language arts, writing in the visual arts classroom entails the correct use of parts of speech, proper capitalization and accurate punctuation. Again, social studies and art concepts are made more meaningful when there is evidence from a primary source or any uninterpreted source of information such as letters, diaries, first person accounts and visual images such as photographs and artworks.

Also, reading a classical sculpture requires a similar approach to reading a pop art painting even though the characteristics that make sculpture classical or painting pop art are not the same. In addition optical art which started in Europe and the United States in the1960s appeared to have been made by computer rather than by hand because lines, shapes and colours of images were exactingly precise. Moreover perspective drawing was developed by Renaissance artists Brunelleschi, Alberti, Ucello and Piero della Francesca and grew from the artists' fascination with mathematics.

Adams (1999) also describes Leonardo da Vinci's *"Vitruvian Man*" which illustrates the observation made by Vitruvius that, "if a man extends his four limbs so that his hands and feet touch the circumference of a circle, his navel will correspond to the center of the circle" (p.547)

In addition they make mention of origami (the art of paper folding) which is traditionally associated with the Japanese culture and integrated into everyday life. Perhaps, Lyon and Ridley (1995) cannot agree more than to say that, their art and language arts courses is designed for the teachers of art and language art courses to inspire creative expressions in words and images through the application of Japanese Art.

Stephens and Walkup also describe and give credit to John Venn (1834-1923:P.26) as the creator of "what is widely known today as Venn Diagrams" which are commonly used to describe, compare and contrast characteristics of events, objects, people, situations, wants, ideas or concepts.

Again, she explains that art often served an educational function during the middle ages in Western Europe where Bible stories and legends of saints were communicated to a largely illiterate population through the sculptures, paintings and stained glass windows in churches and cathedrals. Cornett (2003:P.7) cannot agree less because to her the arts were the first and remain the primary forms of human communication and she is of the opinion that "the arts teach us that all thoughts and feelings cannot be reduced to words". Mann (2004) says that the concept of learning should always include the concept of fun in order to bring the sense of play to the task of learning.

Dickinson (1997) is also of the view that, the development of curiosity and wonder creates a personal and social consciousness that is necessary for living in our culturally diverse world. Eventually, students are set on a lifelong journey with the arts; by encouraging ongoing, informed perception, appreciation and relationship with the people of the world.

On the other hand Hepworth (2002) is of the view that when there are few heroes, students will recognize the positive character traits of heroes through the use of music, arts, creative writing and literature. Probably, there are other heroes in other fields that seem to have overshadowed the art thus the arts also help to make heroes for healthier recognition.

Riley (as cited in Cornett, 2003) says that the arts teach young people how to learn by giving them the first step: the desire to learn. Again Matisse (as cited in Cornett, 2003) says that creation in itself begins with a vision. Perhaps it means that when people are not visionary nothing new is brought about.

"What Works" (1986) as cited in Cornett, 2003 also has it that children who are encouraged to draw and scribble stories at an early age will later learn to compose more easily, more effectively, and with greater confidence than children who do not have this encouragement.

Trueman (1971) also says that to strive for an environmentally-oriented curriculum in Junior High School art and also offers the teachers numerous suggestions for incorporating environmental learning into the arts curriculum. He gives examples of how learning in art can be directed in ways that lead to increased awareness and perception of the environment and the treatment of the problems in that environment.

According to Shusterman (1992, 2000:P.232) "art exist everywhere" and Cornett shares in this opinion as she says that "an education infused with the arts delivers precisely the kind of thinking skills that the 21st century workplace demands…it nourishes imagination and creativity while focusing deliberately on content and end products."

Richards (2003) contends that associating the arts with improving students' academic achievement is not a new phenomenon. He explains that he has been assisting in the effort to make connections to reading and writing concepts due to the fact that, at the end of the1998-99 academic school year, test results showed that approximately 90% of kindergarteners who were involved with the literacy strategy read on or above grade level. Oddleifson (1997) argues that children in schools which teach the arts as basic academic subjects do much better than other kids, in many different ways.

Cornett (2003) agrees that art has a lot to offer even other subject areas and also Arnheim says that any good work in biology or mathematics is done when the student's natural curiosity is awakened, when the desire to solve problems and to explain mysterious facts is enlisted, when the imagination is challenged to come up with new possibilities. In the same way, scientific work or the probing of history or the handling of a language is every bit as artistic as drawing and painting (as cited in Cornett 2003).

According to Schaller (1999) drawing (which is also art) is the language of architecture and that despite innumerable changes in technology, aesthetics and economics, some form of drawing consistently endures as the fundamental way in which any architect expresses his or her vision of structures which are yet to be built to clients, to the public, to himself or herself and to fellow architects.

2.5.2 Historic Purpose

Ntiforo (1977:P.25) refers to a story in which Picasso had finished painting his famous "Guernica", a panting considered a most powerful visual symbol of horror of war explains that his work is only a representation of "the conditions of society" at the time of the wanton Nazi bombing of a small Spanish city bearing the name of this painting.

Again, Grimshaw (1996:P.26), describes Guernica as a town in northern Spain, which was bombed in 1937 by German planes during the Spanish Civil War. This resulted in the death of many innocent people. Thus, Grimshaw sees Pablo Picasso's 1937 painting Guernica, as one of the most famous and dramatic images of war and also believes that it "shows the horror the artist felt at the bombing".

The Microsoft Encarta (2007) also carries this same story that Spanish artist Pablo Picasso painted *Guernica* in 1937 in reaction to the German bombing of the Spanish town of the same name. Francisco Franco, the Fascist general who eventually defeated Republican forces in the Spanish Civil War, ordered the bombing, which decimated this town in the Basque region of northeastern Spain. Picasso took only two months to complete his huge oil painting, which depicted the anguish and suffering caused by the bombing.

Man has always felt a natural edge or impulse to depict what he sees, to express his experiences pictorially and give visual interpretation to his emotion and that art is an expression of a creative mind. There is no wonder therefore that one of the creative things a child does is pick up a crayon or pen and scribble.

Thus from the various narrations by Ntiforo, Grimshaw and the Encarta 2007told of Guernica, the power of emotion is expressed by Pablo Picasso, the history about the city and the meticulously accurate historic painting is all captured vividly and the art piece is probably serving the purpose of a museum.

Again, Adams (1999) mentions the High Renaissance era with the important architectural ideals that preoccupied many artists and writers with the Circle and Centrally Planned Churches. Adams describes Leonardo da Vinci's church plan as having resemblance with the Holy Sepulcher in Milan and talks about the octagonal plan of the drawing having a composition of eight geometric shapes arranged in a circle. Also, Donato Bramante's plan of the church with projected courtyards shows that from the geometrical center, equidistant lines can be drawn to each column just as they can from the navel of Leonardo's *Vitruvian Man,* which lies at the center of the circle.

Fowler (1991) thinks that the arts may well be the most telling imprints of any civilization and how the world has changed because he says they (the arts) are living histories of eras and peoples, and records and revelations of the human spirit as we see transformations in art works. Durer (as cited in Stephens and Walkup 2001:P.107) has said that "Art is hidden in nature and he who can draw it out possesses it".

Adams (1997) affirms that the arts bridge the gap between past and present and may be used as a primary means of exploring a culture that never developed written document such as prehistoric cave paintings dating as far as 30,000 B.C. Adams further argues that, by observing the way children make pictures, sculptures and buildings before learning to read or write, we can see that art is inborn therefore it helps the child in all efforts to create order from disorder and form from formless.

Adams explains Bramante's conformity to Vitruvius's view that the order should correspond to the god to whom the temple was dedicated which to him was suitable for the active male gods-a category consistent with Saint Peter's hot-tempered nature.

Perhaps, these artists were versatile and could combine so much under the umbrella of art. Their works rather call to mind architecture but in a broader sense there is an infusion of mathematics and even religion.

2.5.3 Cultural Purpose

The Microsoft Encarta (2007) also has it that, music, dance and body painting are very important parts of in Australia and that these Aboriginal people have lived in Australia for thousands of years. Perhaps, a comparative study of their kind of art from pre-historic times to contemporary Aboriginal culture says it all. Again, Grimshaw says that people from every culture make art. It is evident that in some cultures art is more connected to everyday life than in others but then nearly every area of life is affected by art; therefore life and art are connected

Dartey (1977) also says that art helps the child to think and create things properly and so apart from it being an area where he is trained to observe, look and see things clearly. Grimshaw (1996) describes art as a collection of ideas produced by human skill, imagination and invention and that art is an interpretation of reality. Moreover, "there is evidence from all over the world that our prehistoric ancestors were artists" and also "the earliest examples were made between 40,000 and 10,000 BC" (p.5). It is the ability or skill to express one's self or what is visually beautiful. Art is a visual language which transcends national boundaries, tongues and customs.

Also, humans have used the properties of clay to their advantage through molding and firing mixtures of clay, sand, gypsum or straw to form vessels decorated with paints and glazes. For instance, it is believed that the first clay firing took place in Japan from10,000 to 7000 B.C but recent discoveries in Czechoslovakia have shown that The Goddess Dolni Vestonice, a figurine dates as far back as 25,000 BC. In the same way technologies extended to the use of adobe, a combination of mud and straw as building material, (Stephens and Walkup 2001).

2.5.4 Expressive Purpose

Adams (1997) makes mention of the fact that colours have expressive qualities just as lines and shapes thus red, orange and yellow are generally considered warm perhaps due to their association with the sun whereas blue is considered cool probably due its association with the sky and water. However, colour can have multiple meanings when used grammatically in expression of oneself. “It can symbolize danger, as when one waves a flag in front of a bull. But to “roll out the red carpet” means to welcome someone in an extravagant way and a “red letter day” can speak of the occurrence of something exciting (p.30). Also the great European plague of 1348 is referred to as the Black Death.

Dickinson is therefore of the view that children today are growing up in a highly visual world, surrounded by the images of television, videos, advertising displays, and other media. He also explains that the human brain has a visual cortex that is five times larger than the auditory cortex. Possibly, there is no wonder that students respond so positively when they have opportunities to learn through the visual arts moreover he believes words alone do not reach all students. A picture is indeed worth a thousand words.

The Encarta (2007) further gives some usefulness of colour to both plants and animals. For instance, flowers with brightly coloured petals attract insects which help with pollination and the growth of new plants. Also, some animals use colour as a way of protecting themselves. For example, a poison arrow frog of South America has bright blue skin to warn other animals that it is dangerous. In addition, this is what the Visual Encyclopedia of Science 1994 says "Many venomous snakes are brightly colored as a warning" (p. 120).

Picasso (as cited in Adams 1997) in his "Blue" paintings depict the predominance of blue as the mood-creating element reflects a mood or the state of mind as melancholy and pessimism thus throwing light on expressions such as "to be in a blue mood", "Blue Monday" , "or to have the blues" (p.452). There is therefore a vivid portrayal of one's sense of purpose, a visual language and also the mood in which one is when colour is used.

Notwithstanding this, there is the school of thought that what is seen is a matter of choice. According to Berger (1972:P.7), "seeing comes before words. The child looks, recognizes before it speaks". He rather thinks that the nature of vision is more fundamental than that of spoken dialogue because to him dialogue is only an attempt to verbalize what the eye sees be it metaphorically or literally. Berger seems to suggest that words have verbal authority which may have little or nothing to do with what is vividly seen with the eye. On the other hand, he argues that what one chooses to see is subject to ones choice. He is of the view that the relationship between what we see and what we know can never settle. Moreover, Magritte (as cited in Berger 1972) rather sees an always-present gap that exists between words and seeing.

2.6 The interrelationship between art and science

According to Mason (2007), various themes are investigated, expressed, and communicated through the arts and through such artistic representations and that we share a common humanity and find answers to questions on what life would be without such shared expressions. She does not see science as the sole conveyor of truth and says that while science can for instance, explain a sunrise, the arts convey its emotive impact and meaning. Both are essential to holistic and unified learning. Probably both art and science are important in the sense that if human beings are to survive, we need all the symbolic forms at our command because they permit us not only to preserve and pass along our accumulated wisdom but also to give voice to the invention of new visions. We need all these ways of viewing the world because no one way can say it all.

In some Ghanaian science textbooks the picturesque descriptive comparisons of electrons orbiting the central nucleus of an atom to planets orbiting around the sun make it more significant. Perhaps, the idea about electrons orbiting the nucleus is made more meaningful with the use of movement of planets around the sun which is easily understood.

According to (www.princeton.edu/artofscience/about.htm) in the spring of 2006, the Princeton University community was asked to submit images in the 2006 Art of Science exhibition. For the first time, videos and sounds were produced in the course of research thus, incorporating tools and concepts from science. It was therefore observed that the practices of science and art both involve the single-minded pursuit of those moments of discovery.

Grimshaw (1996) sees a clear link between art and science because she says the ways in which we make art and see the world have been influenced by inventions and scientific discoveries as she makes reference to trained scientists who work to conserve art such as some Egyptian wall paintings so that they do not disintegrate with age. Similarly, she explains that sculptures and monuments could be worn away either by weathering as “carbon dioxide in raindrops may attack and dissolve the surface of stone sculptures or by acid rain” (p.21). She says that in the 15th century Italian craftsmen kept their paint-making formulas secret. However in the 19th century, science has made available machines that allow paint to be made in large quantities and also that both synthetic and artificial pigments have been developed to meet the demands of industry and artists.

Grimshaw also mentions the constructivists working in Russia around 1915 machine-made materials and Vladimir Tatlin (1885-1953) who made sculptures from glass, tin and plaster. Grimshaw further says that when artists became more interested in the human body as subject matter artists like Michelangelo and Leonardo da Vinci were dissecting corpses to find out more about the way bodies worked and to improve their ability to render the human body realistically.

Stephens and Walkup (2001) have mentioned a number of artists who pioneered the study of anatomy which is common to art and science. These include Leonardo da Vinci, Rembrandt and Andreas Vesalius. They also allude to the fact that many illustrations that depict scientific concepts, natural objects and living things can be found in science and biology textbooks.

Also, according to http://www.morning-earth.org/HowLearn.htmt science and art share a lot in common in both areas, we observe nature closely, we image and record our observation, and we discover and express essential qualities and search for pattern and order.

Lehrer (2008) narrates the story of Niels Bohr in the early 1920's who was struggling to imagine the structure of matter but had spent time analyzing the radiation emitted by electrons, and he realized that science needed a new metaphor. The behavior of electrons seemed to defy every conventional explanation. He further explains how when it comes to atoms, language can be used only as in poetry. To him art could reveal fissures in everything transforming the solidity of matter into reality. Ordinary words couldn't capture the data; perhaps words alone were not expressive enough to bring home the preferred meaning. According to Lehrer, electrons were not like planets at all but rather he likened them to Picasso's deconstructed guitar with a blur of brush strokes that only made sense when one stared at it.

Shaw (as cited in Stephens and Walkup 2001:P.89) has said that:

> Scientist and artists both require a keen sense of observation, vital powers of imagination, the persistence to achieve their visions through hard work and perseverance in the face of many challenges, and the ability to communicate their discoveries to a broader audience.

Probably, themes relating to both science and art such as the painting of natural environment depicted in landscapes have been reproduced by many different cultures but the bottom-line is the world is documented as the artist sees it. Apart from this both artist and scientist understand similar concepts such as theories, facts, rules and guidelines.

In addition, Stephens and Walkup (2001), say that both artists and scientists write notations about their works they describe the problems and brainstorm solutions in sketchpads or notebooks. They refer to the artist and inventor Leonardo da Vinci, the original Renaissance man and interdisciplinary model. His high sense of innovation cannot be underestimated.

Adams (1999:P.552) also looks at Leonardo da Vinci's numerous anatomical drawings which illustrate the Renaissance synthesis of art and science. "Among the most intriguing are his studies of fetuses in the womb" in which he depicts an opened uterus with a fetus in a breech position with the umbilical cord, the fetus as seen through the amniotic membrane and other drawings showing how the system of the fetus was linked to the mother's blood supply showing a vivid relationship between science and art. Adams tells of how she does not only see da Vinci's "outstanding draughtsmanship" in his drawings but also tells of Leonardo's obsessive interest in the origins of life and in discovering scientific explanations for natural phenomena. According to www.artic.edu/aic/education/sciarttech/global-pages/g4 da Vinci is best known as an artist whose works were informed by scientific investigation. He observed the world closely, in order to create convincing images of the human form. He believed that the proper meanings of his narrative paintings would emerge only through the accurate representation of human gesture and expression.

According to Janson, (1969) art and science were united in Brunelleschi's discovery of systematic perspective in the era of the renaissance. Da Vinci's work was the climax of this trend. Janson is of the notion that, da Vinci was as a scientist and an accomplished artist and that his importance remains undisputed because there is empirical evidence that Leonardo da Vinci created the modern scientific illustration which is an essential tool for anatomists and biologist. He is the brainchild of contemporary scientific illustration.

Stephens and Walkup (2001) have alluded to the fact that the first colour wheel (which is now familiar to artists) was designed by the scientist Isaac Newton. However, the colour wheel used in photography and the science of optic is not the same, as it is based on the characteristics of the wavelengths of light-electromagnetic radiation-either natural or artificial.

Adams further gives a technical definition of light as "electromagnetic energy of certain wavelengths which, when it strikes the retina of the eye, produces visual sensations" (p.20) and this can be demonstrated by passing a beam of light through a glass prism. She says that "the visible spectrum has seven principal colours-red, orange, yellow, green, blue, indigo (or blue-violet) and violet..." (p.20) and that if these colours are combined light is produced. This very topic in art (Dispersion of white light) is not different from how it is in science. Wiredu, Ansong-Ntiri, Darko, Doku, Pomary (2005:P.67) also explain how a beam of light split up into different colours as it goes through a prism and as it comes out due to refraction. They further explain the dispersion of white light or how "the different colours in light are refracted by different amounts of light to form a spectrum".

Again, the Microsoft Encarta (2007) explains the formation of rainbow as when sunlight shines through raindrops and the raindrops separate the white sunlight into a spectrum of different colours. The Visual Encyclopedia of Science (1994:P.267) also says that "A rainbow shows the colors of the visible spectrum. Sunlight is refracted, or bent, by raindrops in the air, and the white light is split into red, orange, yellow, green, blue, indigo, and violet".

Eisner, (2004:P.2) buttresses the point stating that the practice of education could learn from the arts and that the forms of thinking the arts called to mind and their relevance for reframing conception and also the very foundation of what education could accomplish or achieve. He does not appreciate the fact that science and art seem estranged for reasons such as "science was considered dependable the artistic process was not, science was cognitive, the arts were emotional. Science was teachable, the arts required talent…." He disagrees with the notion that the art and artistry as sources of improved educational practice are considered, at best, a fallback position which is resorted to when there is no science to provide guidance. He believes that the idea that education has something to learn from the arts cuts across the grain of our traditional beliefs about how to improve education. He is of the view that practice rooted in the arts might contribute to the improvement of both the ends and of education. Doughty and Richiger (1975) are also of the view that the purpose of fostering individualized and interdisciplinary science and art activities within elementary classrooms and to provide pupils and teachers with suggestions to encourage the use of zoos, animal parks and natural history museum.

Wilde et al (2009) believe that the purpose of the Art and Science collaboration is to raise public awareness about artists and scientists using technology to explore new forms of creative expression which also increase communication and collaboration between art and science.

Zull (2005) says that it feels rewarding when new objects or actions are created. There is also the fact that creativity is based on the decisions made by the creator. Again, Zull affirms that, we can learn about the connections between arts and neuroscience. He further explains the importance of the arts in school because of their strong association with motivation and interest. Students love and remember their art classes, theater experiences, musical performances, and creative writing. But beyond this, they may also love their algebra, chemistry, and history. In fact, they will love these academic experiences if we allow the normal neurochemistry of learning to take over. To the extent that they provide freedom, creativity, and mastery, the academic basics become an "art."

According to Stephens and Walkup (2001) art production, art discussion and art writing activities can provide concrete examples for exploration of science such as mass, matter and chemical reactions. For instance a sculptor has to be knowledgeable about mass and matter, printmakers ought to be knowledgeable about how certain chemicals react and painters too should know about how the colours they use will remain true over time. It is therefore clear that some careers require both art and science. Students with strong interest in both art and science may consider careers that combine both interest and these include; medical and scientific illustrators, graphic artist, website and software designers, industrial and product designers and architects

2.7 Interdisciplinary curriculum

The concept upon which interdisciplinary curriculum through art is based has come to be known by an array of acronyms or terms such as Comprehensive Art Education (CAE), Discipline-Based Art Education (DBAE), and Integrated Curriculum (Stephens and Walkup 2001) and these approaches maintain art as central to the curriculum. All these approaches aim at bridging and uniting content areas in logical and meaningful ways. There is therefore no doubt that art-based, integrated units of study are far-reaching, wide-ranging, inclusive and intellectually challenging.

Fowler (1996) believes that the purpose of integrated instruction is to help students gain a deep understanding of an important concept that is common to all the subjects involved. He further explains that, the purpose of integrated instruction is to help students gain a deep understanding of a concept that is common to all the subjects involved in order that combining knowledge learned in one area to challenges in another area will serve them well both in school and in real life. Lincoln and Guba (1985) see integration as categorizing or classification of similarities but emphasize on "whether a new incidence exhibits the category properties that have been tentatively identified."(p.342) Ntiforo (1973) in his address given at the Easter Conference of Ghana Art Teachers stated that in the past, nations have not been great in art or in science but in both art and science and therefore called for the contemporary world to see the need for a salubrious interrelationship in the two areas.

According to Glover (1977) the entire curriculum is an interwoven system of concepts that aim at 'living', hence the subjects are inter-related and that there is nothing like uniqueness about any one of them. He further explains that "there is therefore no single subject in the school curriculum that teaches a unique thing that other subjects do not touch on" (p.9). The subjects are inter-related to foster understanding.

Tawiah (1997) is also of the view that every individual possesses the hidden ability to express himself in any conceivable field within human experience. This ability to utilize creative powers acquired through intensive training in a particular sphere of knowledge is what makes a person an artist, scientist or philosopher. There is vivid truth that each individual is endowed with hidden abilities which can be developed or schooled to bring out the best in him/her.

Fowler (1991) emphasizes that the arts are a central and fundamental means to attain objectives. He enlisted the following points as very pivotal; improving the quality of public education simply by raising standards, improving the quality of the nation's teachers, concentrate on the students know-how to activate and inspire them, how to induce self-discipline, and how to help them to discover the joys of learning, the uniqueness of their beings, the wonders and possibilities of life, the satisfaction of achievement, and the revelations that literacy, broadly defined, provides.

Dodds (as cited in Stephens and Walkup 2001) says that disciplinary integration emphasizes an effective way of underscoring and reinforcing what is important. He explains that "disciplinary integration in art is educationally desirable" and "represents the actual ways in which artist and arts-related professionals experience art" (p. 11). Huckabee (2004) says that there is a correlation between the arts and improved test scores and that there is no political disadvantage because there is such broad public support for the arts.

Oddleifson (1997) believes that the infusion of arts has had a profound effect on student understanding, investment, and standards. As a whole, students not only do well on standardized testing measures, but importantly and demonstrably do well in real life measures of learning. Eventually, they are capable and confident readers, writers, and users of math; they are strong thinkers and workers and also they treat others well. The mind seeks to gradually dissolve the stiffness in the divisions between academic areas due developments in science and cultural practice therefore, the fusion or integration has a dramatic effect on the various disciplines.

Fowler (1996) also sees the purpose of integrated instruction as a means of helping students gain a deep understanding of an important concept that is common to all the subjects involved in the integration. He is of the view that student work is geared to specific goals and assessments in those subject areas through which the combination of knowledge learned in one area can be used in another area and by this skills acquired will serve the students both in school and in real life.

Dickinson (1997) has it that the arts are a distinct form of knowledge requiring sustained and demanding work and yielding kinds of empathy, understanding, and skill both equal to and distinctive from those available in chemistry, civics, or shop.

It is evident from the literature review that a lot of work has been done by pervious researchers in the area of assessing the use of the arts in teaching science. This notwithstanding, very little has even been explored or recorded in the country. Manuals and hand books by researchers in Ghana are also difficult to come by. These gaps the researcher would seek to address with this thesis and it could not have come handier.

CHAPTER THREE

METHODOLOGY

3.1 Overview

In this chapter, there is explanation of research method employed in the collection and analysis of data for the purpose of this research work. The chapter deals with the following broad areas: research design, and methodology, population and sampling procedure, data collection instruments, validation of instruments, administration of instruments, data collection procedures and data analysis plan.

3.2 Research Design

Leedy (2002:P.133) argues that a researcher "cannot afford to skim across the surface" of the problem he is researching into because he must dig, investigate or delve deeper to get the overall understanding of the phenomenon he or she is researching into and qualitative research method provides that opportunity. The researcher thus employed this approach because data collected from numerous sources and analyzed was used to construct a rich and meaningful picture of a complex, multifaceted situation.

The qualitative research method offered the most appropriate means of obtaining first hand information on the use of the arts as a tool for teaching science at the Oforikrom Junior High School for the study. The researcher adopted qualitative research method precisely quasi-experimental action research. This is due to the fact that quasi-experiment lends itself to field experimentation. Again, it is partly due to the ostensibly impossible or non-practical nature of the importance of randomness either in the selection of group members in a multiple-groups study or in the presentation of different treatments in a single-group discussion in experimental designs. The essential feature of experimental research is that, the researcher deliberately controls and manipulates the conditions which determine the events in which they are interested, introduced an intervention and measured the difference that it made. The researcher used art in a controlled teaching situation, where teaching of a given topic was done using modeling, dramatization, drawing and painting in one of the two classes and the other class without the arts. In the end both classes of Form One and Two wrote the same test to check the impact of use of art in teaching.

Table 3.1 shows the number of pupils in Forms One and Two for both the experimental group and control group.

Table 3.1 Distinction between students in the experimental and control groups

CLASS	NO. OF STUDENTS IN EXPERIMENTAL GROUP	CLASS	NO. OF STUDENTS IN CONTROL GROUP	TOTAL
7A	41	7B	37	78
8A	39	8B	42	81
TOTAL	**80**	**TOTAL**	**79**	**159**

3.3 Population for the Study

The population for the study was at the Oforikrom Junior High School. The target population included all pupils comprising Forms One, Two and Three pupils. However, the accessible population was a fraction of the pupils in Forms One and Two only. This was made up of 81 males and 78 females making a total of one hundred and fifty nine. The table below shows the various class populations and their gender.

Table 3.2 Population of Pupils in both experimental and control groups

CLASS	NUMBER OF MALES	NUMBER OF FEMALES	TOTAL
7A	21	20	41
7B	18	19	37
8A	20	19	39
8B	22	20	42
TOTAL	**81**	**78**	**159**

3.4 Sampling techniques and description

Kumekpor (2002:P.132) explains sampling as "the use of definite procedure in the selection of a part for the express purpose of obtaining from its description or estimates certain properties and characteristics of the whole". It is therefore a process which involves careful examination of selected proportion of units of a phenomenon in order to extend knowledge to the whole from which that unit was selected. Different sampling designs may be more or less appropriate in different situations but the researcher chose convenience sampling because this is an action research by a teacher in her own class with her pupils.

3.5 Data Collection Instruments (Observations, Interviews and Questionnaire)

Given (2008:P.185) says that the term "*data* refers to a collection of information".

Three data collection techniques observations, interviews and questionnaire were employed for this study.

3.5.1 Observation

According to Kumekpor (2002), observation can be considered as basic to all scientific investigation probably because it helps to acquire firsthand knowledge of a particular phenomenon. In this study, the researcher was a participant observer and was with pupils throughout the period of teaching which aided her to become part of class activities while at the same time taking notice of these activities and pupils' general attitude in class.

3.5.2 Interviews

Given (2008) explains interview as a conversational practice where knowledge is produced through the interaction between an interviewer and an interviewee or a group of interviewees. Unlike everyday conversations, the research interview is most often carried out to serve the researcher's ends, which are external to the conversation itself (e.g., to obtain knowledge about a given topic or some areas of human experience). Many different forms of interviewing exist. Interviews can be formally conducted in surveys, through the internet, over the telephone, or in face to-face interaction, and they can be informally conducted; for example, as part of ethnographic fieldwork. In this research, however, the researcher used the Focus Group Discussion to get information from groups of pupils from both control and experimental groups to know the level of impart of the independent variable "the use of arts in science lesson" on the dependent variable (the exams and assessment). The researcher carried out interviews soon after the pupils had written test based on selected lessons for the study. This was because the researcher wanted interviewees group responding at the same time and place.

3.5.3 Questionnaire

Kumekpor (2002:P.156) says that "a questionnaire is a form or a document containing a number of questions on a particular theme, problem, issue or opinion to be investigated". These questions are intended to be answered by a particular or specified group or individual deemed to be well-informed enough about questions to which answers should be given. A question can be structured (definite, concrete and directed) or unstructured which consist of partially complete statements. Again, a questionnaire can be self-administered which is characterized by the absence of the interviewer or the personal interview type in which there the presence of the interviewer asking questions and recording answers given by the respondent. On the contrary, student had to write out their own answers to reply to questions posed.

Copies of a questionnaire was administered to only pupils in experimental groups to enable them give individual opinions of class learning experiences and activities as they used the arts in the course of the lesson.

3.6 Practical Projects

Four lessons were taught in all; two of these lessons were taught in Form One and two in Form Two. The lessons objectives for each topic have been stated here.

3.6.1 Lesson on Fish Culture

Objectives for the lesson on fish culture were that the child would be able to draw, identify the main parts of a fish and state their functions as well as state the importance of eating fish and some benefits of rearing fish. There were two lessons done with these objectives in mind; one lesson in the Control Group One (i.e. the ordinary instruction Class One) and the Experimental Group One being the art intervention Class One. The Integrated Science Book One had a drawn and labeled diagram of a Fish.

3.6.2 Lesson in Control Class Group One

Chalk board illustrations, diagrams from textbook were the ordinary visual art used in the Control Group One. The Plate 3.1 below is a labeled diagram on the structure of fish in the Junior High School Pupils' Book which pupils easily have access to. Both the control and the experimental group in Form One used this labeled diagram as shown on Plate 3.1 in their lesson.

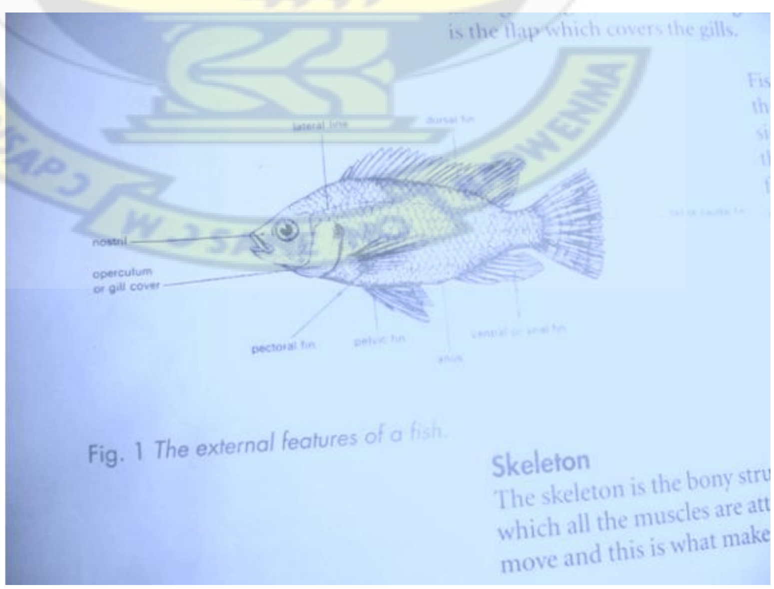


Plate 3.1: labelled diagram of a fish from Pupils' Textbook

3.6.3 The use of chalk board illustrations in the Control Group One

Plates 3.2 and 3.3 below show a classroom situation of the usual teaching and learning in the control class. The fish was drawn on the chalk board and children were called in turns to identify the various parts of the fish.

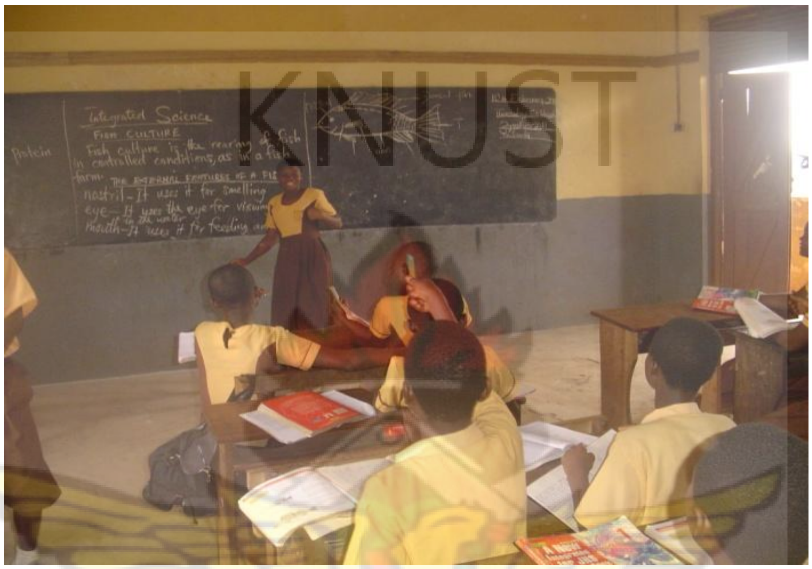


Plate 3.2: Lesson on parts of a fish involving pupils the control group

3.6.4 Practical Work in Experimental Class One

Real objects, chalk board illustrations, *papier mache* modeling, diagram from textbook were used to teach in the Experimental Class One which was the art intervention group one**.**

3.6.5 The Use of Real

The Plate 3.4 is also a real fish which children are very familiar with and can identify with. This was a preserve of the experimental group; the control group was not shown this.

Plate 3.3: Tilapia (Koobi) on a plate

The experimental group shared in all the activities that the control group one engaged in such as the use of drawing from textbooks as shown on Plate 3.1, chalk board illustrations as show on Plates 3.2 and 3.3. In addition, the experimental group engaged in extra activities with the use of real objects, group activities which make pupils use the hand, heart and head to achieve set out goals. For instance, it is only in the experimental group or the art intervention class that there the use of real objects as shown on Plates 3.4 and 3.5 below to identify part of the fish.

Plate 3.4: A female pupil identifying fins of a fish

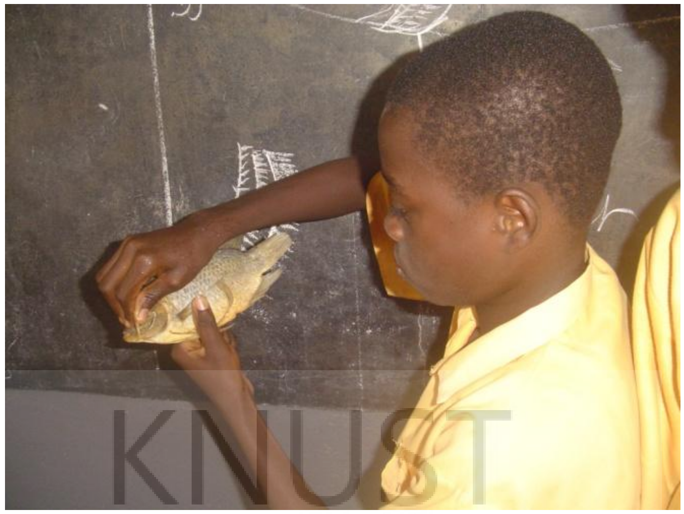


Plate 3.5: A male pupil identifying gills of a fish

A female pupil called to identify a part of the fish had all the cheers from her colleagues because probably they know she is academically weak. She had repeated the class but was still no better than she was the previous year. Therefore her colleagues chuckled when she was called to also identify some parts of the fish. Some of them expressed their dissatisfaction and commented, “Ah! Madam” as if they were advising the teacher against inviting her. However, she proved them wrong and had more applause when she had the answer right. The identification of fish parts with the real fish was for members of the experimental class to reinforce the fish parts drawn in the Pupils’ Text Book One so that any single individual will be able to grasp meanings of the parts of the fish and their functions.

3.6.7 *Papier Mache* modeling

Pupils in the experimental group one class were tasked with making *papier mache* fish model to further reinforce their understanding. The control group one class however, was not given this assignment.

3.6.8 Tools and Materials for *Papier Mache*

The main tools for pounding the paper were the mortar and pestle as shown on plate 3.6.

Plate 3.6: A Mortar and Pestle

The materials needed for the mashed paper included waste paper, cooked starch and white glue as on the plates 3.7 and 3.8. Usually, pupils waste a lot of paper each day. Pupils in the experimental group one class were therefore made to hand pick these papers and keep for a whole term (as part of the advance preparation for the lesson). The pupils kept asking a whole lot of questions. They kept asking, “Madam, what are we going to use the papers for?”, “Madam, can we add this type of paper?”, “Madam, when are we going to use the papers?” The teacher on the other hand kept encouraging and the pupils explained that the papers would be used in molding in place of clay which they were familiar with.

Plate 3.7: Pupils with Cooked Starch

Plate 3.8: A sample of White Glue

3.6.9 Procedure for Making *Papier Mache*

First of all, the paper was soaked in water for about a day or two depending on how supple or inflexible the paper is. Plate 3.9 shows the pupils in Form One that is 7A experimental group soaking paper in water. The Plates 3.10 shows how pupils are doing the pounding of soaked paper.

3.6.10 Class Activities for Experimental (art intervention) Group in Form One

Plate 3.9: Pupils soaking paper in water

Plate 3.10: Pupils pounding paper

In a regular public school the classes are generally large and class control is difficult for the teacher. However, the researcher observed that grouping the pupils and assigning to them responsibilities was a strategy that could be used to teach large classes to maintain a good class control. For both of these reasons the researcher decided to organise the class into smaller task groups to equally interact with others to mold a fish.

Plate 3.11: Pupils adding white glue to pounded paper

Plate 3.12: Pupils sharing pounded paper

In groups, pupils are able to take up leadership roles and they are ready to compete to achieve something worthy of praise. Plate 3.11 shows pupils adding white glue to pounded paper while plate 3.12 shows how a pupil makes balls of the mashed paper probably to give out to the various groups in the experimental class.

3.6.11 The Various Groups in Experimental Group One at work

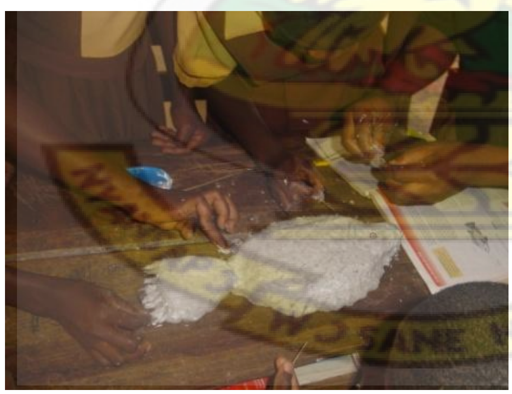


Plate 3.13: molded fish by group one

Plate 3.14: molded fish by group two

Plate 3.15: molded fish by group three

Plate 3.16: molded fish by group four

Plate 3.17: molded fish by group five

The Plates 3.13, 3.14, 3.15, 3.16 and 3.17, show pupils molding fish in their various groups. What the pupils are not familiar with is the pounding of paper and all that the activities entail. This is one thing the pupils were not familiar with as part of integrated science. One pupil was not sure of what the whole concept was about and asked “Madam, are we doing visual art or science”? Another pupil said they only used the mortar and pestle to pound food at home and also in their home economics lessons but not in science. The teacher therefore explained that the molding of paper into fish was only being used to make them enjoy and understand the lesson. One pupil also, expressed the view that he was not good at making things with the hand but was encouraged by the activities.

The Plates 3.18 and 3.19 below show the ability of pupils to go an extra mile to create. The group took pains to use broom sticks to show the gills of fish. The addition of gills in this manner was not the teacher's idea and it shows that there are things the teacher learns from his/her pupils in the course of teaching. Also, pupils were able to explore when they were allowed to do such activities.

Plate 3.18: modeled fish by group two

Plate 3.19: modeled fish by group three

3.6.12 Lesson on Food Web

This lesson was retrieved from www.sitesforteachers.com/perl/rankem.pcgi?id and was adapted to suit this researcher's preference. The lesson was used extensively for the experimental group one class with the use of performance art whereas the control group one class was restricted from the role play or drama. The lesson objectives though, were common to both classes. Objectives for the lesson on food web were that the child would be able to state that part of the rain forest ecosystem is composed of living things that depend on each other, explain that there are different predator/ prey relationships that exist among living members of a community, mention that living things affect each other in an ecosystem and identify food as one of the basic needs of living things.

3.6.13 Lesson in the Control (ordinary instruction) Group One Class

Illustrations from textbook and chart on food chain were used in the control group. Plates 3.20 and 3.21 below show the lecture method of teaching in both the experimental and the control groups. The textbook was the reference material with information on the various topics which could be discussed in class. Pupils, therefore, were guided along the content of the textbook to get definitions, illustrations, explanation and drawings. The relevant information written on the board was then copied by pupils as notes. However, there are some required practical activities which the time allotted to weekly lessons did not allow the teacher to treat lessons wholly.

Plate 3.20: Teacher teaching in 7A class

Plate 3.21: Teacher teaching in 7B class

3.6.14 The Use of Chart on Food Chain in both the Experimental Group and Control Group One in Form One

Illustrations from the Pupils' Textbook and use of charts on food chain were used both in the control class in the experimental class. The Plate 3.22 shows a chart on a food chain. This was displayed and used to teach food chain in both the control and experimental classes. It was realised that both groups were not familiar with dik-dik as given by the chart as they kept asking "Madam, what is dik-dik?" Pupils were therefore encouraged to consider any plant eating animal. Eventually, the picture of grass and leaves made them able to substitute the name dik-dik with herbivores like sheep, goat, rabbit, cow, antelope, grass cutter, to mention a few.

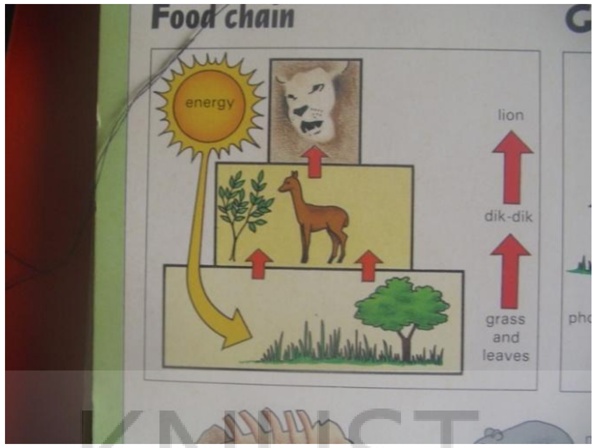


Plate 3.22: A Chart showing a food chain.

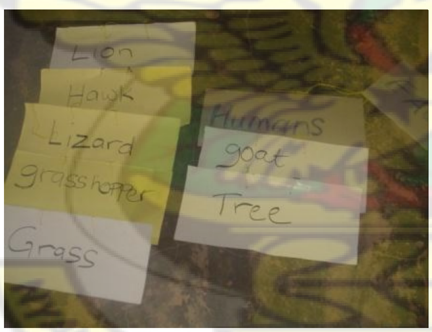
3.6.15 Food Chain/ Food Web Activities in the Experimental (art intervention) group

The teacher again engaged the experimental group, food web activities, energy flow activities through hands-on activities to make them role play to dramatize a distinction between food chain as shown on Plate 3.23 and food web as shown on Plates 3.24 and 3.25 below. The pupils could readily read from the cards the names of various organisms they were to role play and some preferred playing the roles of some organisms to others. However, some pupils had to be called to participate in the class activities because they never volunteer to get involved.

Plate 3.23: Food Chain activity

Plate 3.24: Food web activity   Plate 3.25: Food web activity

Prior to this, the teacher had done preliminary activities using labeled cardboards to make series of food chains and food web to see the various links as shown on Plates 3.26, and 3.27. This means that advance preparation on the part of teacher is very necessary to make the lesson successful.



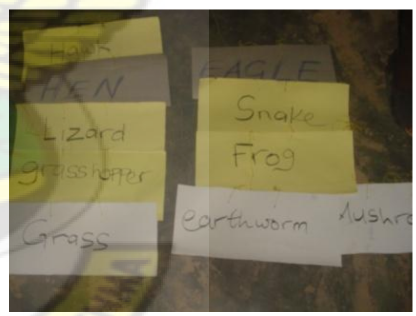


Plate 3.26 :Food chain   Plate 3.27: Food chain

3.6.16 Food Web Activities in the Experimental (art intervention) Group One Class

Apparently the pupils begun calling their colleagues by the various animal roles they played like grasshopper, lizard, hen, goat, hawk etc and they laughed about it. But then, a male pupil who could not take the joke when his friends called him 'snake' was highly provoked and started raining insults back on them. The teacher warned them against such jokes and threatened to punish any culprit severely.

The pupils did series of food web activities to explain the complex feeding relationship that exists comprising of two or more food chains, the different prey/predator relationships and depicting how animals can be prey for various predators. It was obvious that pupils were excited about the role play having the card. Pupils could readily explain that if a part of the food web disappears many other living things are affected. Cornett (2003:P.17) again, uses the Multiple Intelligence theory by Howard Gardener to explain that real understanding is only attained when "a person transforms ideas and skills from one domain to another."

Again, Dickinson (2006) emphasizes on individual differences as he sees pupils with different kinds of abilities and disabilities are in the same classrooms therefore, school systems that rely on teaching primarily through the spoken and written word simply do not reach all these kinds of students..

Plate 3.28: Food web activity

Plate 3.29: Food web activity

3.6.17 Energy flow in the Food chain/ Food Web Demonstrated by the Experimental class

The flow of energy is symbolised here by the use of the yam so that in between every two palms meeting (as shown on Plates 3.31 and 3.32) there is energy being passed on in the form of food. Initially, the pupils were not sure of what the yam balls was going to be used for. They therefore kept asking, “Madam, are we going to eat the yam?” The pupils had the vivid visual picture of what the food web was about and could use arrows to show animals and their way of feeding in a web.

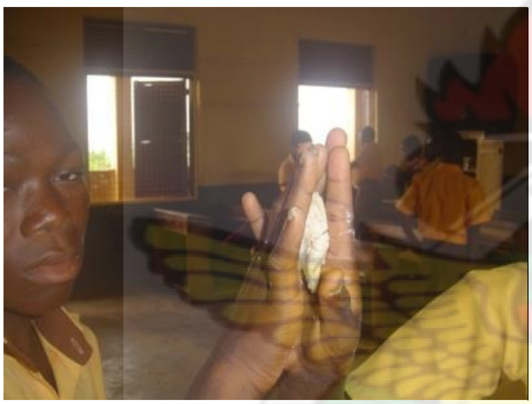


Plate 3.30: Energy flow activity

Plate 3.31: Energy flow activity

Plate 3.32: Energy flow activity

Plate 3.33: Energy flow activity

3.6.18 Lesson on Structure of Atoms

The objectives of this lesson were that, the child should be able to name the first twenty elements, mention the sub-atomic particles in an atom and state their electrical charges, draw the structure of at least five atoms of the first twenty elements and mention the names of atoms having their outermost shells full.

Lessons done using teaching and learning materials (art) effectively are well participated in by all students and their understanding is also boosted. However, the use of these materials could influence the students either positively or negatively.

In Ghana, for instance, beads are common and are used by most ethnic groups, on bodies, in homes for numerous celebrations and ceremonies. Using other objects which may be difficult for children to describe the shape of atoms could confuse pupils if they do not know how they look. Using wire to thread beads is something the pupil can easily identify with.

3.6.19 Class Activities for Control Group in Form Two

The use of charts on the solar system and chalk board illustrations were employed to teach in the control group two. The closest thing children identify with to bring out the structure of the atom is the solar system which children learn about even in the primary school. Perhaps words alone were not expressive enough to bring home the preferred meaning. According to http://www.morning-earth.org/HowLearn.htmt, atoms are tiny specks of matter so small that we cannot even see them with microscopes. Lehrer (2008) is of the view that electrons were not like planets at all. However, the researcher concurs with the use of the chart as the basis for position of the sub-atomic particles. At the same time, Lehrer defies every conventional explanation and expounds that when it comes to atoms, language can be used only as in poetry. To him art could reveal fissures in everything transforming the solidity of matter into reality and that ordinary words could give the same clarification.

Plate 3.34: An already existing Chart showing the solar system.

3.6.20 Tools for Making Atoms (by the Experimental group)

The tools used for making atoms of the first twenty elements include; pliers, cutting knife and tape measure. It may be enough to give scientific explanation with activity where necessary and possible.

3.35: a pair of pliers Plate 3.36: Using a pair of pliers to copper wire

Plate 3.37: tape measure for measuring copper wire

Plate 3.38: Examples of Cutting Knives for removal of insulation from copper wire

Pupils know of some traditional and economical uses of beads. It is customary for females in Ghana to wear beads around their waists. On the other hand, using beads in molding atoms was very uncommon to the pupils at the Oforikrom M/A School. Some male students said that if the copper wire was used to thread the beads, the females would feel uncomfortable wearing them (as if the purpose of the lesson was to produce beads for the females).

Pupils were put into groups as an effective classroom management strategy especially with large classes, for economic use of materials and also to foster sharing of ideas about making models of drawings of atoms done previously. Pupils had been told to liken electrons to planets orbiting the sun, whereas that sun was representative of the nucleus of the atom. Most of pupils could not draw the atoms correctly, therefore, constructing atoms in three-dimensional form using beads and wire helped them to grasp the true nature of the atom, a structure too small to see.

3.6.21 Materials Used for Making Atoms by Experimental Group Two Pupils

Plate 3.39 Glass Beads

Plate 3.40: An Insulated Copper Wire

Plate 3.41: A flexible wire

3.6.22 Class Activities for Experimental Group in Form Two

The pupils are put into groups to build miniature atoms with copper and wire. The tape measure is used to measure the length of copper wire before the pair of pliers is used to cut. The insulation is initially removed with the cutting knife and the copper wire is used to thread the beads as shown in Plates 3.42, 3.43, and 3.44 below.

Plate 3.42:Threading of beads with copper wire by a female pupil

Plate 3.43: Threading of beads with copper wire by a male pupil

Plate 3.44: Threading of beads with copper wire with a cross-section of pupils

Plate 3.45 outcome of modeled atoms

The Plate 3.45 above shows models of atoms of the first twenty elements placed on a surface. However, it was realised that the atoms with beads and wire project was going to be more helpful than initially designed. The Plates 3.46 showing the Periodic Table and 3.47 also showing the Periodic Table with modeled atoms below inculcated into the plan to promote students understanding of the arrangement of elements according to increasing atomic number, the periods and groups.

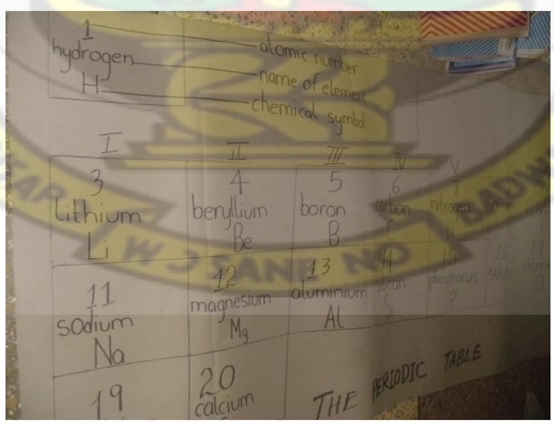


Plate 3.46 A Periodic Table showing the first twenty elements

Plate 3.47 Periodic Table with modelled atoms from Glass Beads and Copper wire

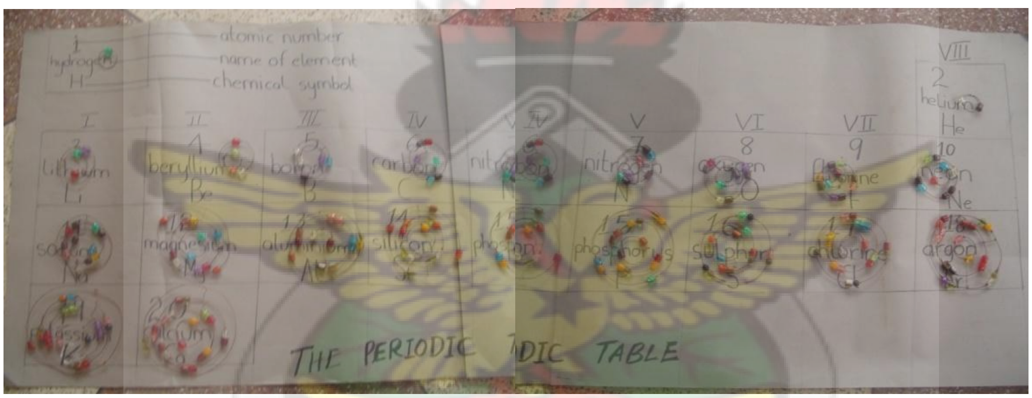


Plate 3.48 Periodic Table with beaded atoms

3.6.23 Lesson on Carbon Cycle

Objectives of the lesson were that the child would be able to explain that there are repeated patterns of change in nature, give some reasons why the carbon cycle is important, state some human activities that disrupt the carbon cycle, explain the effects of the disruption on the environment and identify two processes that release carbon dioxide into the atmosphere and a process that removes carbon dioxide from the atmosphere.

3.6.24 Charts for both Control and Experimental Groups in Form Two

The charts on the carbon cycle are readily available in the school and since they relate to the carbon cycle lesson they were used to support teaching in both the controlled and the experimental groups. The Plate 3.48 is about the gas cycle giving a vivid visual description of the plant use of carbon dioxide in the atmosphere released through respiration by animals. The plant in turn releases oxygen as a by-product of photosynthesis which is again used in respiration. That is, it was explained that plants were the only organisms capable of putting the carbon dioxide to good use to benefit other living things including man. Plate 3.50 shows the release of carbon dioxide into the atmosphere by vehicles. Plate 3.51 shows the cutting down of trees for firewood. Plate 3.54 to Plate 3.56 illustrate the serious environmental impact of more carbon dioxde released into the atmosphere.

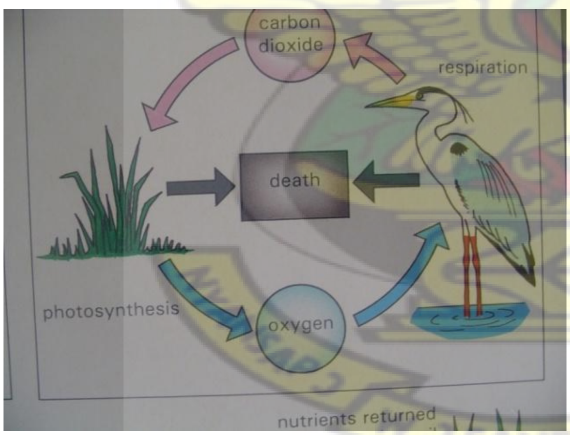


Plate 3.49: A Chart showing Gas Cycle

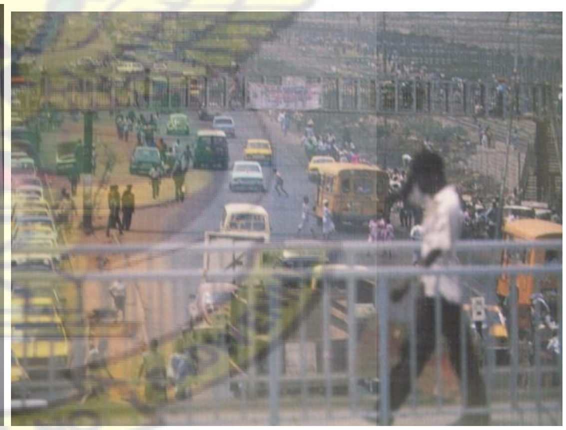


Plate 3.50: A Chart showing the release of carbon dioxide into the atmosphere by vehicles.

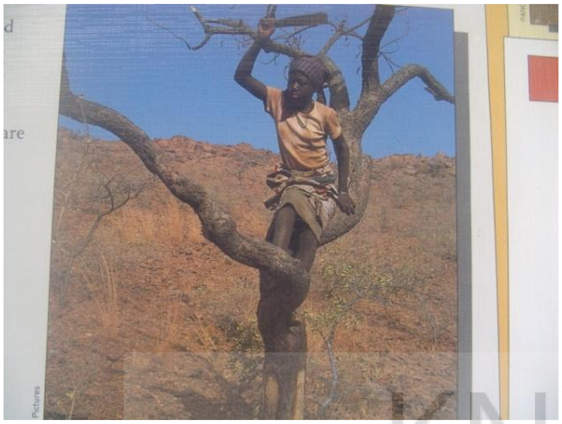


Plate 3.51:A Chart showing the cutting down of trees for firewood.

Plate3.52:A Chart showing the cutting down of trees

Plate 3.53: Logging operations

Plate 3.54: Bush burning

Plate 3.55 Chimneys release of polluting gases

Plate 3.56 Chimneys release of polluting gases

3.6.25 Class Activities for Control Group in Form Two

The carbon cycle was explained and illustrated on the board for class discussion. The illustration of the carbon cycle showed the two pathways of how carbon dioxide is released into the atmosphere and also how it is removed from the atmosphere. Pupils were then called in turns to a explain the cycle to the hearing of classmates using the illustration according to their understanding as shown on Plates 3 3.57 below. It was however observed that there was low listening ability and concentration for that matter on the part of some pupils on Plates 3.58, 3.69 and 3.70, possibly because it seemed more like a lecture.

Plate 3.57 Carbon Cycle   Plate 3.58 Little student involvement

In the Plate 3.57 a student has been called to the front of the class to use a pointer to identify and explain the carbon cycle as the other students do the listening. However, Plate 3.58 shows that the students on the other hand are unable to be solely involved with what is going on in class as some are partially involved and others do their own thing. Plate 3.59 shows a student using a chart to explain the carbon cycle; however, the illustrations can only be useful to a small group at a time due to the small nature of the drawings and writings on the chart.

Plate 3.59 Students Listening

3.6.26 Class Activities for Experimental (art intervention) Group in Form Two

Plate 3.60: Sharing of paper for group work   Plate 3.61: Sharing of paper for group work

The experimental group two on the other hand, was put in groups and given the task of creating visual explanation on the carbon cycle. Plates 3.60 and 3.61 above show how pupils are making paper ready for the various group works to begin. The Plates 3.62, 3.63, 3.64 and 3.65 below are pupils in the experimental group of Form Two investigating interpretation of the carbon cycle so as to give it a visual description. Apart from the group of pupils who produced Plate 3.65 worked in pencil, all the other groups used poster colour to work. All the same, each group produced good visual explanations of the lesson taught

Examples of Group Works done by the Experimental Class showing Pupils' Visual Interpretation of the Carbon Cycle

Plate 3.62: Drawing on carbon cycle

Plate 3.63: Drawing on carbon cycle

Plate 3.64: Drawing on carbon cycle

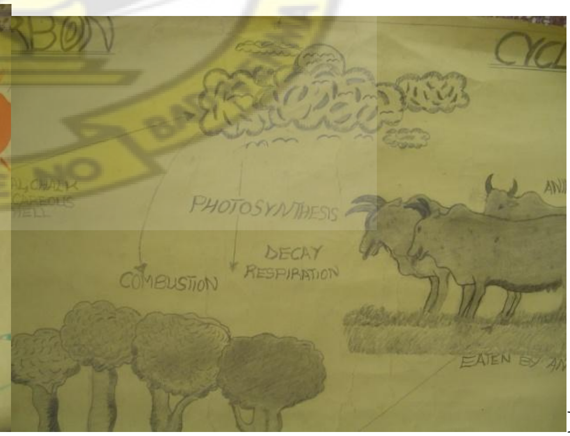


Plate 3.65: Drawing on carbon cycle

3.7 Data Analysis Plan

Summaries of the data collected were prepared immediately after transcribing the field notes from interviews, questionnaire administration and classroom observation procedures and organised into individual reports reflecting the situation on the ground. Nonetheless, the researcher found the need to triangulate information for the sake of integrity and enhancing the findings' internal validity, interview data were compared with information obtained from other sources. Statistical tables, charts and plates were used to compile the data. The deduced findings have been interpreted using descriptive analysis.

CHAPTER FOUR

PRESENTATION AND DISCUSSION OF FINDINGS

4.1 Overview

This chapter entails a systematic presentation of a careful analysis of the data gathered from questionnaire, interviews and observations made in the course of teaching activities in both control (ordinary instruction) and experimental (art intervention) groups in Forms One and Two. The data were collated based on the following objectives: 1) to demonstrate the interrelationship between science and art. 2) to develop a strategy for art as an integral element in teaching science. 3) to examine and analyze the use of art as an instrument for teaching science.

4.2 Discussion of Teaching and Learning the Different Experiences in Control and Experimental Groups

The table below shows four lessons done in both the art intervention (experimental) group and the ordinary instruction (control) group and the various classroom teaching-learning experiences that actually transpired.

The situation here was that the researcher teaches a particular science topic introducing more of art activities in the experimental group whereas the same topic is taught in the control group as a usual classroom teaching. At the end of the different classroom experiences, the same assessment questions were used for both the art intervention groups and the ordinary instruction groups to find out how well or poorly the use of the arts have imparted on the students. Lesson plans for the four topics taught have been put in the Appendix A, B, C, D, E, F, G and H**.**

Table 4.0 Activities aimed at reinforcing the arts in the Experimental group as against the normal teaching in the Control group.

	Instructional Materials and Art Activities used by Experimental group	**Teaching and Learning Materials used by the Control group**
Lesson 1 Fish Culture	Fish, chalkboard illustrations, papier mache modeling and diagram from textbook.	Chalk board illustrations and diagram from textbook.
Lesson 2 Food Web	Illustration from textbook, food web activities, energy flow activities and use of charts on food chain	Illustration from textbook and use of charts on food chain
Lesson 3 Carbon Cycle	Charts, chalkboard illustration and drawings by school children	Charts and chalkboard illustrations
Lesson 4 Atoms	Use of chart on the solar system, molding of atoms using beads and copper wire as well as chalk board illustrations	Use of chart on the solar system and chalk board illustrations

4.3 The impact of the art intervention in the experimental groups as against the control groups.

The assessment questions based on each of the four lessons are attached at the Appendix A, B, C, D, E, F, G, H and I. It was noticed that even though most students from the experimental group could give correct answers to written tests, some students in the control group also excelled in the test. Fowler (1991) argues that, there is the need to provide the fuel that will ignite the mind, spark the aspirations, and illuminate the total being. The arts can often serve as that fuel in the sense that they are the ways through which we apply our imagination, thought, and feeling through a range of "languages" to illuminate life in all its mystery, misery, delight, pity, and wonder. Again, Riley (as cited in Cornett 2003) says that the arts teach young people how to learn by giving them the first step that is the desire to learn.

4.4 Lesson on Fish Culture

. There were two lessons on fish culture. One lesson was done with the control group where chalkboard illustrations and diagrams, and the other with experimental group one which was the art intervention Class One where real fish, chalkboard illustrations, *papier mache* modeling and diagram from textbook were used.

Table 4.1 Fish parts and functions 1A (experimental group)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	eye for viewing objects in water	2	4.9	4.9	4.9
	mouth for breathing and feeding	1	2.4	2.4	7.3
	any three of the above	2	4.9	4.9	12.2
	all of the above	36	87.8	87.8	100.0
	Total	41	100.0	100.0	

Table 4.2 Fish parts and functions 1B (control group)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	eye for viewing objects in water	1	2.7	2.7	2.7
	mouth for breathing and feeding	1	2.7	2.7	5.4
	any three of the above	6	15.2	15.2	21.6
	all of the above	29	78.4	78.4	100.0
	Total	37	100.0	100.0	

Generally, most pupils in both the experimental and control groups could state parts and functions of the fish correctly and also state the importance of fish farming. This is possibly the result of the pupils in both control and experimental groups getting access to the labeled diagram of fish in the Pupils Textbook Book One.

It was however, observed that the more pupils in the experimental class performed better than those in the control class as shown in the Tables 4.1 and 4.2. The percentage of students who could explain functions of all the parts was 87.8% in the art intervention group one class but 78.4% in the ordinary instruction group one class. It can be deduced that only 12.2% in the experimental class could not state all the functions of the fish parts whereas 21.6% in the control class could not do the same. This implies that the percentage of pupils in the art intervention class who performed better than those in the ordinary instruction was 9.4% . It implies that the modeling of the fish by the experimental group had gone a long way to help them to learn the parts of the fish with more ease than the control group who did not have this experience.

It is can also be seen from the Tables 4.1 and 4.2, that the pupils who had the art intervention performed better in terms of their ability to identify the parts of the fish and state the functions of these parts. The use of arts such as drawing, modeling and real objects in teaching the Fish Parts and Functions really paid off. Richards (2003) says associating the arts with improving students' academic achievement is not a new phenomenon. Again, drawings done on the fish were reasonably accurate.

Pupils in both the art intervention and ordinary instruction classes could generally give satisfactory responses to questions on the importance of eating fish and the benefits derived from fish rearing.

4.5 Lesson on Food Web

Objectives for the lesson on food web were that the child would be able to state that the rain forest ecosystem is composed of living things that depend on each other, explain that there are different predator/ prey relationships that exist among living members of a community, mention that living things affect each other in an ecosystem and identify food as one of the basic needs of living things.

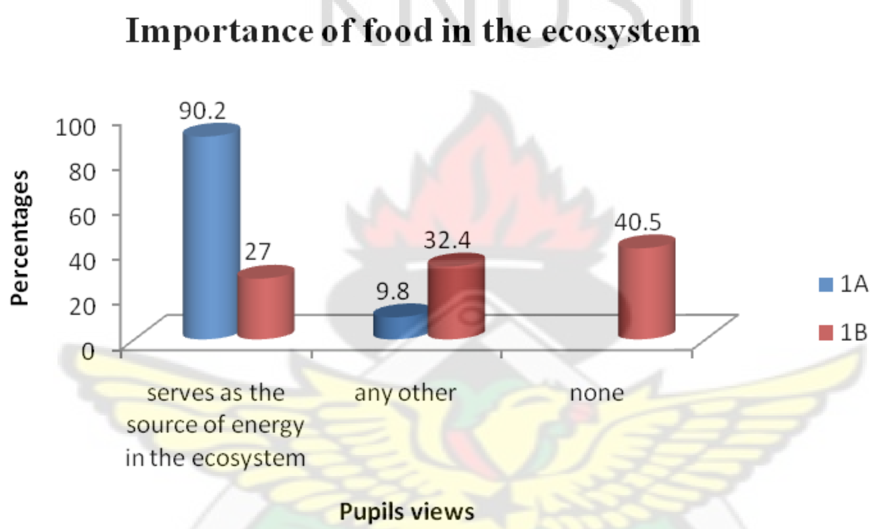


Fig. 4.1 Importance of food in the ecosystems

1A- Art intervention (experimental group)   1B-Ordinary Instruction (control group)

Pupils in the art intervention class were made to engage in dramatization to demonstrate food chain, food web and energy flow in the lesson, however; the ordinary instruction class did not take part in all these activities. The pupils in the art intervention class benefited greatly from the energy flow activity as it shows in Figure 4.1. The sharp contrast between the students' responses was very good. The percentage of pupils who mentioned food as the source of energy was 90.2% whereas only 27% from the ordinary class could give answer to the questions correctly. More pupils from the ordinary instruction class (32.4%) gave answers such as “it builds the body”, “enables us to grow well” as well as “the bases for life and survival”. The percentage of pupils from the art intervention class who gave such equally good answers was 9.8%. Most pupils from the ordinary instruction class (40.5%) could simply not give answers at all. This could undoubtedly have come about as a result of the lecture method used to teach in that class.

Table 4.3 How living things affect each other 1A (Experimental/ art intervention group)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	bacteria and fungi help in decomposition of dead organisms	3	7.3	7.3	7.3
	birds/insects serve as agents of pollination	4	9.8	9.8	17.1
	birds serve as agents of fruit/seed dispersal	4	9.8	9.8	26.8
	Other valid answers	11	26.8	26.8	53.7
	None	0	0	0	53.7
	any two of valid answers	19	46.3	46.3	100.0
	Total	41	100.0	100.0	

Table 4.4 How living things affect each other 1B (Control/Ordinary instruction group)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	bacteria and fungi help in decomposition of dead organisms	3	8.1	8.1	8.1
	birds/insects serve as agents of pollination	6	16.2	16.2	24.3
	birds serve as agents of fruit/seed dispersal	3	8.1	8.1	32.4
	Other valid answers	19	51.4	51.4	83.8
	None	3	8.1	8.1	91.9
	any two of valid answers	3	8.1	8.1	100.0
	Total	37	100.0	100.0	

.

Tables 4.3 and 4.4 show that pupils expressed different opinions on how living things affect each other in the ecosystem. Pupils were expected to give two of the many answers. The various answers given included, "bacteria and fungi help in decomposition of dead organism", "bird and insects serve as agents of pollination" and "birds serve as agents of seed and fruit dispersal". Other views included, "animals and humans eat plants", "parts of some animals serve as host for others", "some tree branches served as home for some animals". The pupils in the art intervention had 19 representing 46.3% giving two of such answers whereas in the ordinary instruction class, only 3 students gave two of such answers representing 8.1%.

Also, 3 students in the ordinary instruction class forming 8.1% failed to provide answers and this was not the case in the art intervention class because 53.7% of the pupils gave at least one of the above valid answers. Nonetheless 83.8% of pupils in the ordinary instruction class also gave one correct answer. This clearly shows that more pupils in the ordinary class gave one out of the two expected answers than the art intervention group. There were 38.2% more of the art intervention group who mentioned all two answers expected. It is obvious that the pupils in the art intervention class had their interest boosted in the dramatization used in teaching and it shows in the performance of pupils in the experimental class.

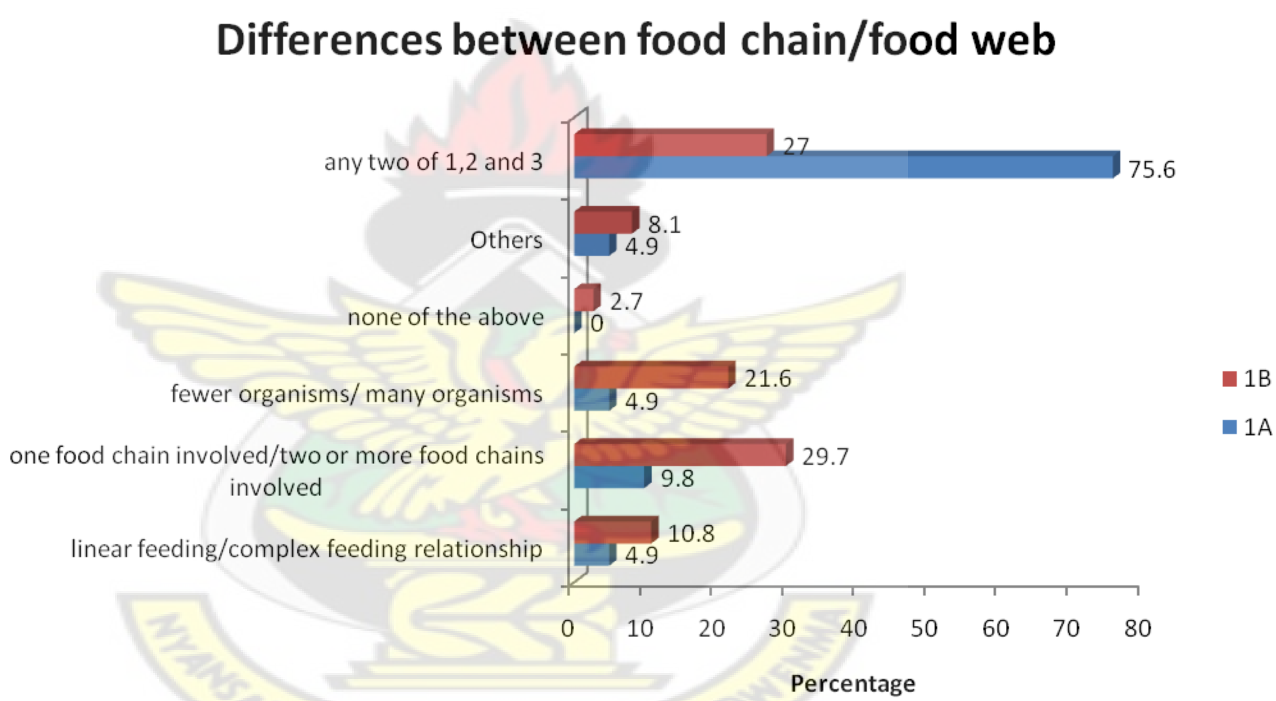


Fig.4.2 Differences between food chain/food web

1A-Art intervention (experimental group)   1B-Ordinary instruction (control group)

The Figure 4.2 presents pupils' understanding of differences between food chain and food web. It is obvious from the varied answers given that 75.6% of the art intervention class could identify three correct answers whereas 27% in the ordinary instruction class could do the same. This means that, pupils in the art intervention class could easily identify with the role-play activities employed under food chain and food web. However, the ordinary instruction group did not have the role-play experiences, therefore did not understand the lesson very well as shown in the poor performance they put up. Also, 2.7% of the ordinary instruction group gave no answers at all but this did not happen in the art intervention class. At least, 24.4% of the art intervention class could give at least one difference between food chain and food web but 70.3% also in the ordinary instruction class did the same. This therefore shows that the arts are very helpful in teaching of Integrated Science lesson.

Table 4.5 Predator/prey relationship1 A (Experimental/art intervention group)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	hawk-hen,mouse,crocodile-fowl,tiger/lion-deer/antelope,snake-mouse/frog	31	75.6	75.6	75.6
	any four of the above,	6	14.7	14.7	90.3
	any three of the above,	2	4.8	4.8	95.1
	any two of the above,	1	2.4	2.4	97.6
	Other valid answers	1	2.4	2.4	100.0
	None	0	0	0	0
	Total	41	100.0	100.0	

In addition to this, the general responses to examples of predator/prey relationship were good. Conversely, the number of pupils in the art intervention class who gave up to five expected correct answers was 31 representing 75.6% but the ordinary instruction class registered a number of 18 students representing 48.6% as shown on Tables 4.5 and 4.6 below. This means that more students in ordinary instruction class gave fewer correct examples of the predator/prey relations than the art intervention class.

Table 4.6 Predator/prey relationship 1 B (Control/Ordinary instruction group)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	hawk-hen,mouse,crocodile-fowl,tiger/lion-deer/antelope,snake-mouse/frog	18	48.6	48.6	48.6
	any four of the above,	1	2.7	2.7	51.4
	any three of the above,	3	8.1	8.1	59.5
	any two of the above,	10	27.0	27.0	86.5
	None	5	13.5	13.5	100.0
	Other valid answers	0	0	0	
	Total	37	100.0	100.0	

The number of students who had four correct answers in the art intervention class was 6 representing 14.7% while only 1 pupil representing 2.7% of the ordinary instruction class had four answers correct. This shows that pupils involvement in the experimental class such as drama on food chain/food web activities mentioned earlier in Plates 4.27, 4.28

and 4.29 made them remember what they learned better than learning through route method. From all the discussion so far, it was only in the ordinary instruction class that 5 pupils representing 13.5% had no valid answers to give. The pupils in the ordinary instruction class mostly gave invalid answers such as “monkey and banana”, “snails and green leaves”, “dogs and bones”, “rat and maize”. This brought out the fact that explanations and meanings of “prey” and “predator” were not clearly understood by more pupils in the control group. According to, www.blog.montessorifeveryone.com/science experiments chosen make the lesson ambiguous or clear to the learner. This may be due to the fact that sometimes teachers are tempted to do the most dramatic experiments and demonstrations in the name of fun or getting learners interested in science. However, even if the teachers give a truthful explanation for the idea they may be illustrating, the students may abandon their words for the sake of their own form of logic if their minds are not ready for it.

4.6 Lesson on Structure of Atoms

The objectives of this lesson were that, the pupil would be able to name the first twenty elements, mention the sub-atomic particles in an atom and state their electrical charges, draw the structure of at least five atoms of the first twenty elements and mention the names of atoms having their outermost shells full.

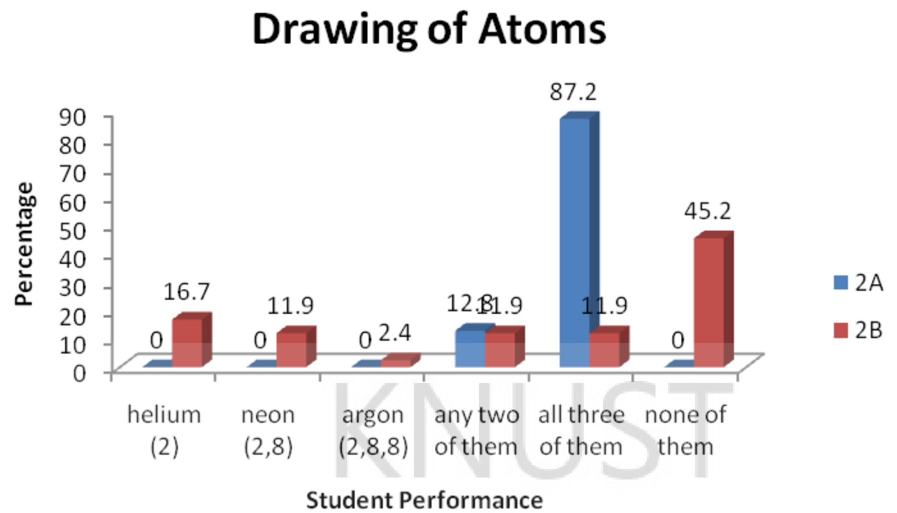


Fig. 4.3 Drawing of atoms

1A- Art intervention/experimental group 1B- Ordinary instruction/control group

The lesson on atoms was more encouraging in the art intervention class which employed modeling of atoms using beads and wire. The pupils in the ordinary instruction class on the other hand, were not able to perform up to the standard exhibited by the experimental group. The drawing of the atoms saw 87.2% of pupils in the art intervention class being able to draw all three atoms correctly whereas 11.9% in the ordinary instruction class were able to do same see Figure 3 above.

Figure 4.3 shows 45.2% of pupils in the ordinary instruction class were unable to draw any of the atoms. The percentage of pupils who were able to draw only two of the atoms required was 12.8% in the art intervention class but 11.9% in the ordinary instruction class. The percentage of pupils who could do just one drawing was 42.9% in total. The contrast between the performances of these two classes is very diverse. The art intervention class really benefitted from the modeling of the atoms as discussed earlier.

Table 4.7 Description of outermost shells 2A (Experimental/art intervention group)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	their outermost shells are full	33	84.6	84.6	84.6
	inability to describe	6	15.4	15.4	100.0
	Total	39	100.0	100.0	

Table 4.8 Description of outermost shells 2B (Control/ordinary instruction group)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	their outermost shells are full	5	11.9	11.9	11.9
	inability to describe	37	88.1	88.1	100.0
	Total	42	100.0	100.0	

The art intervention group had the advantage of being able to identify the molded atoms therefore it reflected in their description and naming of the noble gases as shown on Tables 4.7, 4.8 and Figure 4. The number of pupils who were able to name and describe the noble gases in the art intervention class far exceeded that of the ordinary class. With the description of the outermost shells of the art intervention class had 84.6% as against the 11.9% of the ordinary intervention. Those who were unable to describe them in the art intervention class formed 15.4% and 88.1% in the ordinary instruction.

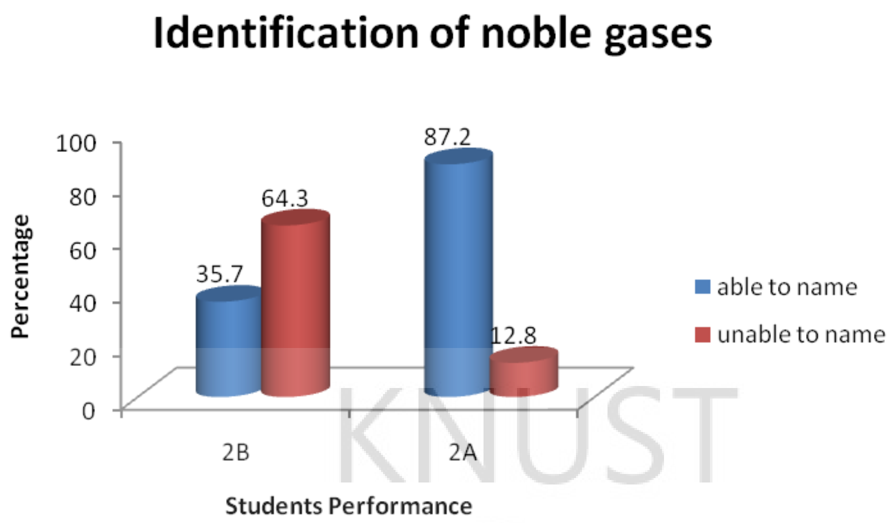


Fig. 4.4 Identification of noble gases

2A-Art intervention/Experimental group 2B-Ordinary instruction/Control group

The Figure 4.4 shows that the art intervention class had 87.2% being able to identify drawn atoms as noble gases while the ordinary class had 35.7%. This implies that a percentage of 51.5% more in the art intervention class could do better with the description of the drawn atoms than those of the ordinary instruction class. On the other hand, the ordinary class had 64.3% who could not identify these atoms as against 12.8% of the art intervention class. Thus, more students in the ordinary instruction class could not provide correct answers than those students in the art intervention class.

Table 4.9 The 1st twenty elements and their symbols 2A (Experimental/art intervention class)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	ability to write all names and symbols correctly	33	84.6	84.6	84.6
	ability to write more than half names and symbols correctly	3	7.7	7.7	92.3
	ability to write less than names and symbols correctly	2	5.1	5.1	97.4
	inability to write names and symbols correctly	1	2.6	2.6	100.0
	blank paper	0	0	0	
	Total	39	100.0	100.0	

Table 4.10 The 1st twenty elements and their symbols2B (Control/ordinary instruction class)

		Frequency	Percent	Valid Percent	Cumulative Percent
	ability to write all names and symbols correctly	6	14.3	14.3	14.3
	ability to write more than half names and symbols correctly	4	9.5	9.5	23.8
	ability to write half names and symbols correctly	4	9.5	9.5	33.3
	ability to write less than names and symbols correctly	18	42.9	42.9	76.2
	inability to write names and symbols correctly	9	21.4	21.4	97.6
	Blank paper	1	2.4	2.4	100.0

Similarly, 33 pupils representing 84.6% of the art intervention class were able to list all the first twenty elements and their symbols correctly but only 6 pupil making 14.3% of the ordinary intervention could do the same as shown in Tables 4.9 and 4.10 above. This signifies that 70.3% more gave correct answers in the art intervention group than the ordinary intervention group. This is probably due to the fact that the art intervention group learnt the names as well in the course of modeling of the atoms. The number of pupils who were unable to write the names of the first twenty and their symbols in the art intervention/experimental group was one representing 2.6% but 9 students representing 21.4% were unable to do likewise in the control/ordinary instruction group.

4.7 Lesson on Carbon Cycle

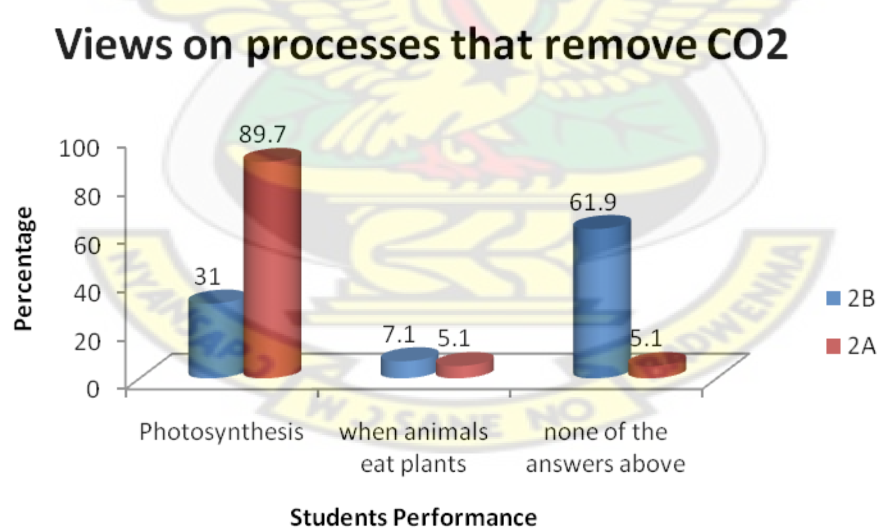


Fig. 4.5 Views on processes that remove CO2

2A-Art intervention/experimental 2B-Ordinary instruction/control

Objectives of the lesson were that, the pupil would be able to explain that there are repeated patterns of change in nature, give some reasons why the carbon cycle is important, state some human activities that disrupt the carbon cycle, explain the effects of the disruption on the environment and identify two processes that release carbon dioxide into the atmosphere and a process that removes carbon dioxide from the atmosphere.

Figure 4.5 shows disparities in the performances of the two classes. Whereas 89.7% of pupils in the art intervention class could mention photosynthesis as one way of removing carbon dioxide 31% of those in the ordinary instruction class could. The ordinary instruction group had 7.1% giving the eating of plants as the other correct answer but the art intervention class had just 5.1%. This means that in all the total percentage of pupils from the art intervention group who could give correct answers was 94.8% as against 38.1 in the ordinary instruction group. Therefore, 47.7% more of students in the art intervention class performed better than the ordinary instruction group. However, the percentage of students who mentioned none of these answers in the ordinary instruction group was as high as 61.9% but 5.1% in the art intervention class. The visual explanation that the art intervention class was made to give to the carbon cycle probably gave them a better understanding than the ordinary instruction class.

Some aspects of the lesson were generally good for both the art intervention class and the ordinary instruction class. For instance, both groups of students could generally mention importance of the carbon cycle as "through photosynthesis oxygen is made available for respiration", "when animals and plants die decomposition helps to release carbon dioxide in them". "Through respiration and other human activities carbon dioxide is released for photosynthesis".

Table 4.11 Two processes which release Carbon dioxide 2A (art intervention class)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	respiration, combustion	7	17.9	17.9	17.9
	combustion, decomposition	29	74.4	74.4	92.3
	Decomposition	1	2.6	2.6	94.9
	Respiration	2	5.1	5.1	100.0
	Combustion	0	0	0	
	none of the above	0	0	0	
	Total	39	100.0	100.0	

Table 4.12 Two processes which release Carbon dioxide 2B (ordinary instruction class)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	respiration, combustion	4	9.5	9.5	9.5
	combustion, decomposition	10	23.8	23.8	33.3
	Decomposition	4	9.5	9.5	42.9
	Respiration	5	11.9	11.9	54.8
	Combustion	6	14.3	14.3	69.0
	none of the above	13	31.0	31.0	100.0
	Total	42	100.0	100.0	

On the other hand, the experimental class was able to again outshine the control group in their responses to mention two ways through which carbon dioxide was released and one way in which carbon dioxide was removed from the atmosphere. As shown in Tables 4.11 and 4.12. It is evident from the Tables 4.11 and 4.12 that, thirty-six students representing 92.3% of the pupils in the art intervention class could mention two processes that result in the release of carbon dioxide into the atmosphere as against fourteen pupils representing 33.3% of the pupils in the ordinary instruction group. The number of pupils in the art intervention class who could mention one out of the two required were three in the art intervention class, representing 7.7% whereas 15 pupils, representing 35.7% of the ordinary instruction had only one process mentioned. Table 4.12 shows that as many as 13 pupils from ordinary instruction class representing 31% could not mention any of the processes. The differences in this outcome could be attributed to the group work drawing and discussion which was part of the art intervention one class which the other class did not have.

4.8 Findings from the Questionnaire Administered

Questionnaire was administered to pupils in the art intervention groups to enable them offer individual views of their learning experiences in the use of the diverse forms of arts in teaching the different science topics such as Fish Parts and Functions, Food chain and Food web, Structure of Atoms and Carbon Cycle.

A total of 80 copies of the questionnaire representing 100% were administered to the art intervention classes one and two.

Almost all the 80 pupils believed that drawings and diagrams make Integrated Science lessons easier to understand. The pupils gave varied opinions on what they gained from the use of the dramatization, modeling, drawing and painting in the Integrated Science lessons. To some, the art intervention helped to foster understanding whereas others said it helped to sustain their interest and also encouraged them to overcome reading difficulties. The answer “No” dominated pupils responses when they were asked whether talking drawings (the arts) should be done away with used in Integrated Science lessons. Some pupils also said that the drawings made difficult topics easy to understand.

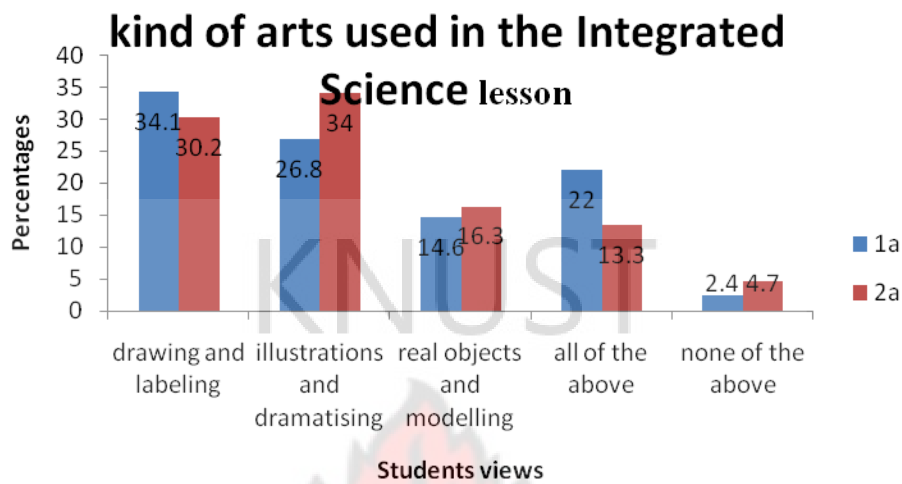


Fig. 4.6 Kinds of arts used in Integrated Science lesson

Pupils in the art intervention classes one and two had become used to a wide variety of the arts used in their Integrated Science lessons as they were able to mention and list a number of these examples as shown in the Figure 4.6 such as modeling, drama, use of charts, illustration and the like. Majority of pupils also mentioned that they enjoyed the use of drawings, making models, charts, real objects, illustrations and drama or role-play.

Figure 4.6 shows the variety of the arts which pupils mentioned have helped them to understand some lessons in Integrated Science. A total of 64.3% of pupils mentioned drawing and labeling, 60.8% identified illustration and dramatization while 30.9% attributed their understanding of the lesson to the use of real objects and modeling. A total number of 35.3% stated that the different forms of arts used such as drawing and labeling, illustration and dramatization and also real objects and modeling made understanding of the different aspects of the lessons taught very simple and easy to understand. A small percentage of the students 7.1% of the experimental group could not give any answers at all. This is because regardless of the wide variety of arts intervention with the experimental group a few pupils can neither read nor write at the Oforikrom M/A Junior High School.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

This research was determined to use arts to teach science in the Oforikrom M/A Junior High School. The objectives of the research that are to establish the interrelationship between science and art to develop a strategy for art as an integral element in teaching science and to examine and analyze the use of art as an instrument for teaching science.

The researcher was guided by these objectives, whiles also focusing on the Research Questions which are:

1) What is the correlation between art and science?
2) What strategies should be devised to integrate art in the teaching of science?
3) How effective is the use of the arts as an instrument in teaching science at the Junior High School?

The researcher employed qualitative research method to carry out this study. The research instruments were observation, interviews and questionnaire. The researcher studied and examined some of the topics in integrated science and strategies in art which are considered pivotal in the teaching of science at Junior High School. The researcher adopted qualitative research method precisely quasi-experimental action research. This is due to the fact that quasi-experiment lends itself to field experimentation. Again, it is partly due to the ostensibly impossible or non-practical nature of the importance of randomness either in the selection of group members in a multiple-groups study or in the presentation of different treatments in a single-group discussion in experimental designs.

Main Findings

The research findings establish the following by means of this research work on teaching of science using the arts bearing in mind the objectives of the research.

1. In line with Objective One of the study to guide pupils demonstrate the interrelationship between science and art. Pupils in the art intervention/experimental group were made to use real object, *papier mache* modeling as discussed earlier on Plates 3.9 to 3.17, identify parts of the fish. Food web and food chain activities were also used in a performance art situation to enable students distinguish between food chain and food web, energy flow activities (as shown on Plates 3.24 to 3.33 earlier) in which energy was symbolized by the use of cooked yam to explain the importance of food in the ecosystem. Again, after the lesson on the carbon cycle pupils in the art intervention/experimental group were put into groups and tasked with making visual representation of the lesson for onward discussion (which normally happens in visual art). Also, pupils were able to model atoms using beads and copper wire to enhance their knowledge on the structure of atoms of the first twenty elements of the Periodic table. Generally, the attitude of pupils such was very appreciable and to a large extent this objective was achieved. The researcher concurs with Grimshaw (1996) who sees a clear link between art and science because she says the ways in which we make art and see the world have been influenced by inventions and scientific discoveries, and also Fowler (1996) who

believes that the purpose of integrated instruction is to help pupils gain a deep understanding of an important concept that is common to all the subjects involved.

2. Objective Two was to develop a strategy for art as an integral element in teaching science. The strategy involved grouping pupils into experimental and control. The experimental group explored with a wide diversity of arts to teach a particular lesson whereas the control group got the usual teaching with little or no arts. Both groups wrote the same assessment test to enable the researcher find out about the impact of arts used. Also, group work was used to help in developing teaching strategies for large classes through assigning responsibilities. The researcher agrees with (Starko 1995 as cited in Cornnet, 2003) that "it seems only logical that encouraging [children to be] explorers and questioners than passive acceptors cannot help honing creativity, thinking and learning" (p.48). One activity started helped to find more or new activities which could eventually solve an existing problem. For instance, the drawing of atoms was enhanced by the using copper wire and beads to build the models then the idea of using these atoms for a periodic table of the first twenty elements as shown in Plates 4.55 and 4.56.

3. Objective Three was to examine and analyze the use of art as an instrument for teaching science. Based on the test assessment given to both the art intervention/experimental and the ordinary

instruction/control groups after lessons taught, there was ready test results for analysis to be done. Figure 4.1 mentioned earlier shows the responses of pupils on the importance of food in the ecosystem as "food serves as a source of energy", "basis for life and survival" and other viable answers both in the art intervention/experiment and the ordinary instruction/control. The percentage of pupils in the art intervention group who gave correct answers was 90.2% whereas the ordinary instruction group had 27% of the pupils did the same. This means 62.8% more of the art intervention group performed better than the ordinary instruction group. However, 40.5% of the ordinary instruction group could not give any correct answers but none of the students from the art intervention class gave an incorrect answer. The researcher agrees with Dickinson (2006) who argues that school systems that rely on teaching primarily through the spoken and written word simply do not reach all kinds of students.

Also, from Tables 4.3 and 4.4 mentioned earlier students expressed different opinions on how living things affect each other in the ecosystem. The students in the art intervention had 19 of them representing 46.3% giving two of such answers whereas in the ordinary instruction only 3 students gave two of such answers representing 8.1%. Also, three students in the ordinary instruction class representing 8.1% failed to provide an answer which was not the case in the art intervention class because there 53.7% gave at least one of the above valid answers but 83.8% students in the ordinary instruction class also gave one correct answer. This is clearly showing that more students in the ordinary intervention group gave one out of the two expected answers than the art intervention group.

There were 38.2% more of the art intervention group who mentioned all two answers expected. It is obvious that the students in the art intervention class had the interest boosted in the performance art used in teaching as shown earlier.

In addition to this, the general responses to examples of predator/prey relationship were good. Conversely, the percentage of pupils in the art intervention class who gave up to five correct answers was 75.6% but the ordinary instruction class registered 48.6% with the same yardstick as shown on Tables 4.5 and 4.6 below. It is also shown that more students in ordinary instruction class gave fewer correct examples of the predator/prey relations than the art intervention class. The number of pupils who had four correct answers in the art intervention class was 6 representing 14.7% while only 1 person representing 2.7% of the ordinary instruction class had four answers correct. This shows that pupils involvement in class activity such as drama made them remember what they learned better than the usual spoon-feeding with information. It was only in the ordinary instruction class that 5 pupils representing 13.5% had no answers given.

The Figure 4.3 mentioned earlier shows 45.2% of pupils in the ordinary instruction class were unable to draw any of the atoms but the percentage of pupils who could do just one drawing in the same class was 42.9% in total. The percentage of pupils who were able to draw only two of the atoms required was 12.8% in the art intervention class but 11.9% in the ordinary instruction class. The contrast between the performances of these two classes is very diverse. The art intervention class really benefitted from the modeling of the atoms as discussed earlier. The art intervention group had the advantage of being able to identify the molded atoms therefore it reflected in their description and naming of the noble gases as shown on Tables 4.7, 4.8 and Figure 4 below. The number of pupils who were able to name and describe the noble gases in the art intervention class far exceeded that of the ordinary class. With the description of the outermost shells of the art intervention class had 84.6% as against the 11.9% of the ordinary intervention. Those who were unable to describe them in the art intervention class formed 15.4% and 88.1% in the ordinary instruction.

From the foregoing and former analysis carried out in chapter four, it can be seen that analyses on the use of the arts as an instrument for teaching science was well achieved.

5.2 Conclusions

It is evident from the foregoing that art can be useful as an integral part of teaching integrated science at the basic level of education. Pupils are able to do well in Science when arts are used in science lessons (where applicable). For instance, a pupil who was known to perform poorly in class was able to score a good mark in written test.

Pupils selected from four classes for the purpose of this study were made up of two control groups or ordinary instruction group and two experimental groups which made use of drawing, modeling, dramatization and also real objects. It was also noticed that the experimental group gave more correct answers to written tests given. For this reason, dramatization, the use of modeling, drawing and painting should be explored in teaching Integrated Science.

Most pupils with reading difficulties are able to use the arts to make meaning from lessons taught and to express their understanding.

5.3 Recommendations

In view of the evaluation and observations made via this research work on teaching of science using art, the following recommendations should be considered:

1. Dramatization, the use of modeling, drawing and painting should be used as a tool for teaching Integrated Science at the Junior High Schools to make it easier and enjoyable.
2. Teachers should vary their methods of teaching integrated science and integrate more child- centred lessons such as hands-on and visually-oriented activities to ensure that their students' different abilities are catered for.
3. The Curriculum Research and Development Division should find out about how best the curriculum can be integrated to foster understanding of related areas. This would ensure that lessons are not superficially treated.
4. The Ghana Education Service should see to proper supervision of teaching and learning at the Junior High Schools to ensure that lessons are not treated abstractly.
5. Parents should be made to understand that the arts are used in all subjects to boost children's interest especially in Integrated Science.
6. Collecting and recycling of materials such as used paper should be explored for use in constructing materials for teaching and learning of integrated science. By

so doing, the pupil will learn how to reuse some materials and at the same time, manage some waste.

7. Science Resource Centres as well as Art and Science Museums should be provided at the basic levels of education in the various sub-metros and districts of education in Ghana to help pupils develop interest in science at an early age.
8. The Guidance and Counseling Unit of the Ghana Education Service should work hand in hand with schools to guide pupils towards where their abilities and interests are.

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APPENDICES

APPENDIX A

FISH CULTURE LESSON PLAN

Form: 1A (EXPERIMENTAL GROUP)   Timeframe: 1 – 70 minute sessions

Topic: FISH CULTURE   **Sub-topic: Parts and functions of a fish**

Reference: Teaching Syllabus for Integrated Science (JHS) page 11

Relevant Previous Knowledge: Children have been eating fish.

Objectives: by the end of the lesson the child, the child will be able to draw, identify the main parts of a fish, and state their functions, state the importance of eating fish and some benefits of rearing fish.
TLM: SALTED FISH, CHART SHOWING STRUCTURE OF THE FISH, MASHED PAPER

LESSON (INTRODUCTION)

Review the relevant previous knowledge on the lesson on whether they consume fish, and how often they eat fish.

DEVELOPMENT

- Write fish culture on chalkboard and ask children to mention the food nutrient derived from eating fish.
- Use chart and digital content to identify the parts of the fish.
- Lead children to identify the various parts of a fish and state their functions: e.g. nostril for smelling, eyes for seeing, mouth for eating and breathing, operculum for covering and protecting the gills, the lateral lines detect vibration or movement in the water and also pressure change, the dorsal fin prevents the fish from rolling sideways.
- ***Put children into six groups of five and guide them to prepare papier mache to use in molding the fish.***

CONCLUSION: Conclude the lesson by giving exercise based on the lesson.

ASSESSMENT: Draw a well labeled structure of a bony fish.

- Mention five parts of a fish and state their functions.

APPENDIX B

FISH CULTURE LESSON PLAN

Form: 1B (CONTROL GROUP)
Timeframe: 1 – 70 minute sessions

Topic: FISH CULTURE **Sub-topic: Parts and functions of a fish**

Reference: Teaching Syllabus for Integrated Science (JHS) page 11

Relevant Previous Knowledge: Children have been eating fish.

Objectives: by the end of the lesson the child, the child will be able to draw, identify the main parts of a fish, and state their functions, state the importance of eating fish and some benefits of rearing fish.
TLM: CHART SHOWING STRUCTURE OF THE FISH

LESSON (INTRODUCTION)

Review the relevant previous knowledge on the lesson on whether they consume fish, and how often they eat fish.

DEVELOPMENT

- Write fish culture on chalkboard and ask children to mention the food nutrient derived from eating fish.
- Use chart and digital content to identify the parts of the fish.
- Lead children to identify the various parts of a fish and state their functions: e.g. nostril for smelling, eyes for seeing, mouth for eating and breathing, operculum for covering and protecting the gills, the lateral lines detect vibration or movement in the water and also pressure change; the dorsal fin prevents the fish from rolling sideways.

CONCLUSION: Conclude the lesson by giving exercise based on the lesson.

ASSESSMENT:

- Draw a well labeled structure of a bony fish.
- Mention five parts of a fish and state their functions.

APPENDIX C

FOOD WEB LESSON PLAN

Form: 1A (EXPERIMENTAL/ART INTERVENTION GROUP)
Timeframe: 1 – 70 minute sessions

Topic: Ecosystem

Sub-topic: Food web

Reference: Teaching Syllabus for Integrated Science (JHS) page 19

Relevant Previous Knowledge: Children have learnt about the food chain.

Objectives:
By the end of the lesson the child will be able to

1. State that part of the rain forest ecosystem is composed of living things that depend on each other.
2. Explain that there are different predator/ prey relationships that exist among living members of a community.
3. Mention that living things affect each other in an ecosystem.

4. Identify food as one of the basic needs of living things.

Materials needed:

· Balls of yarn
· Role cards depicting rain forest animals for food web activity

Charts

Illustrations from textbook

Lesson:

Introduction

1. Review and discuss concept of food chains from previous lesson to introduce lesson. **Development**
2. Launch: Write Food Web on board. What do you think a food web is?

   · Most living things are part of more than one food chain.

   · The many food chains in an area are combined, or linked, to form a web.

   · Discuss examples of food chains from rain forest animals studied, depicting how animals can be prey for various predators

   3. What would happen if a part of a food chain disappeared? When one part of the food web is affected, many other living things are affected also

   4. Do Food Web Activity utilizing a rain forest ecosystem:

   a. Give each student a role card to pretend to be; put around their neck and form a large circle

   b. Assign students without cards to be helpers

   c. Have each student read aloud card of what they are and what they eat, students with matching cards raise hands
3. d. Have helpers give one end of yarn to student reading card and the other ends to students raising hands (yarn is symbol of energy being passed in form of food) a web will be formed when finished

Conclusion

5. Closure: What might happen if the plants of the rain forest were destroyed? Everything will be affected

a. Cut the strings of the rain forest plant to show that it's dead. All animals that eat phytoplankton will also die so strings also need to be cut. Continue cutting until all animals are dead.

Assessment:

1. Identify that part of the rain forest ecosystem is composed of living things that depend on each other.
2. Identify different predator/ prey relationships that exist among living members of the tropical rain forest community.
3. How important is food in the ecosystem?

4. Explain how living things affect each other in an ecosystem.

APPENDIX D

FOOD WEB LESSON PLAN

Form: 1B (CONTROL GROUP)
Timeframe: 1 – 70 minute sessions

Topic: Ecosystem

Sub-topic: Food web

Reference: Teaching Syllabus for Integrated Science (JHS) page 19

Relevant Previous Knowledge: Children have learnt about the food chain.

Objectives:
By the end of the lesson the child will be able to

1. State that part of the rain forest ecosystem is composed of living things that depend on each other.
2. Explain that there are different predator/ prey relationships that exist among living members of a community.
3. Mention that living things affect each other in an ecosystem.

4. Identify food as one of the basic needs of living things.

Materials needed:
1. Charts

2. Illustrations from textbook

Lesson:

Introduction

4. Review and discuss concept of food chains from previous lesson to introduce lesson. **Development**

5. Launch: Write Food Web on board. What do you think a food web is?

· Most living things are part of more than one food chain.

· The many food chains in an area are combined, or linked, to form a web.

· Discuss examples of food chains from rain forest animals studied, depicting how animals can be prey for various predators

3. What would happen if a part of a food chain disappeared? When one part of the food web is affected, many other living things are affected also

4 lead children to engage in class discussion and notes writing on the topic

Conclusion

5. Closure: What might happen if the plants of the rain forest were destroyed? Everything will be affected

Assessment:

1. Identify that part of the rain forest ecosystem is composed of living things that depend on each other.
2. Identify different predator/ prey relationships that exist among living members of the tropical rain forest community.
3. How important is food in the ecosystem?

4. Explain how living things affect each other in an ecosystem.

APPENDIX E

CARBON CYCLE LESSON PLAN

Form: 2A (EXPERIMENTAL GROUP)
Timeframe: 1 – 70 minute sessions

Topic: Cycles

Sub-topic: Carbon cycles

Reference: Teaching Syllabus for Integrated Science (JHS) page 27

Relevant Previous Knowledge: Children have learnt about the food chain.

Objectives:
By the end of the lesson the child will be able to

1. Explain that there are repeated patterns of change in nature.
2. Give some the carbon cycle is important
3. State some human activities that disrupt the carbon cycle.
4. Explain the effects of the disruption on the environment.

5. Identify and explain the stages in the carbon cycle.

Materials Needed:
· Lighted candle
· A chart depicting activities that bring about disruption in the carbon cycle.

Lesson:
Introduction:

1. Previous Knowledge: Review and discuss concept of the part of air breathed out from previous lesson.
2. Launch: Write carbon cycle on board. What do you think a carbon cycle is?
· living things release carbon dioxide through respiration.
· There are many human activities that result in the release of carbon.
· Discuss how carbon atoms circulate in the environment.
3. What are the stages involved in the carbon cycle? Discuss the two main stages of carbon cycle as: i) The removal of carbon from the atmosphere such as the process of photosynthesis.

ii) The release of carbon back into the atmosphere such as respiration, decomposition and combustion. Let children do role play by making them all breath in and out for onward discussion. Also let them light a candle and discuss the part of air being released into the atmosphere.

4. What is the importance of importance of carbon cycle: (use illustration to show the cycle)

a. through carbon cycle, carbon dioxide is made available for plants to make their food.

b. Through photosynthesis, oxygen is released to both plants and animals.

c. the growth of other animals, which feed on green plants, also provide man with food (meat).

5. In what ways are the carbon cycle disrupted? Display chart depicting activities that bring about disruption in the carbon cycle

a. Deforestation or depletion of vegetation.

b. Excessive release of carbon (IV) oxide from industries and exhaust fumes of cars into the atmosphere.

6. What are the effects of the disruption of the carbon cycle?

a. greenhouse effect or global warming.

b. high concentration of carbon dioxide in the atmosphere

c. depletion of the ozone layer

d. put the students into groups and give them assignment to make a visual representation of the carbon cycle.

5. Closure: What might happen if the carbon circulation in the atmosphere ceased? Without carbon cycle oxygen in the atmosphere would get finished.

Assessment:

1. What is meant by the carbon cycle?
2. Mention two importance of the carbon cycle.
3. State five human activities that disrupt the carbon cycle.
4. Explain how the disruption of the carbon cycle affects the environment.
5. Identify and explain the stages in the carbon cycle.

APPENDIX G

ELEMENTS LESSON PLAN

Form: 1A (EXPERIMENTAL GROUP)
Timeframe: 1 – 70 minute sessions

Topic: ELEMENTS, COMPOUNDS & MIXTURES
Sub-topic: Structure of atoms

Reference: Teaching Syllabus for Integrated Science (JHS) page 20

Relevant Previous Knowledge: Children have been introduced to the first twenty elements on the periodic table and their symbols.

Objectives: by the end of the lesson the child, the child will be able to name the first twenty elements, mention the sub-atomic particles in an atom, and draw the structure of at least five atoms of the first twenty elements.
TLM: CHART SHOWING STRUCTURE OF THE SOLAR SYSTEM, ORANGES, TENNIS BALL, MASHED PAPER

LESSON (INTRODUCTION)

Review the relevant previous knowledge on the lesson on the first twenty elements and their symbols.

DEVELOPMENT

- Use models and chart to explain the structure of an atom.
- Draw the structure of an atom and label its parts.
- Mention and discuss the sub-atomic particles in an atom.
- Guide children to draw the distribution of electrons in atoms of the first twenty elements of the periodic table.
- ***Put children into six groups of five and guide them to prepare papier mache to use in molding the fish.***

Conclude lesson by giving exercise based on the lesson
ASSESSMENT: Draw atoms for the following elements showing the distribution of their electrons. I) sodium II) potassium III) oxygen IV) chlorine V) magnesium

APPENDIX H

ELEMENTS LESSON PLAN

Form: 1B (CONTROL GROUP)
Timeframe: 1 – 70 minute sessions

Topic: ELEMENTS, COMPOUNDS & MIXTURES
Sub-topic: Structure of atoms

Reference: Teaching Syllabus for Integrated Science (JHS) page 20

Relevant Previous Knowledge: Children have been introduced to the first twenty elements on the periodic table and their symbols.

Objectives: by the end of the lesson the child, the child will be able to name the first twenty elements, mention the sub-atomic particles in an atom, and draw the structure of at least five atoms of the first twenty elements.

TLM: CHART SHOWING STRUCTURE OF THE SOLAR SYSTEM, ORANGES, TENNIS BALL

LESSON (INTRODUCTION)

Review the relevant previous knowledge on the lesson on the first twenty elements and their symbols.

DEVELOPMENT

- Use models and chart to explain the structure of an atom.
- Draw the structure of an atom and label its parts.
- Mention and discuss the sub-atomic particles in an atom.
- Guide children to draw the distribution of electrons in atoms of the first twenty elements of the periodic table.

Conclude lesson by giving exercise based on the lesson
ASSESSMENT: Draw atoms for the following elements showing the distribution of their electrons. I) sodium II) potassium III) oxygen IV) chlorine V) magnesium

APPENDIX I

FISH CULTURE (Form 1) Assessment

1. Draw and label the external features of a fish.

2. Mention five parts of the fish and state their functions
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3. State any two importance of eating fish.
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4. State four benefits of fish farming.
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5. The organs which contain eggs and sperm in a fish are called
………………………………..

6. When we eat a fillet of a fish, we are eating …………………………………

7. Baby fish used to stock a fish farm are called…………………………………………….

8. Which of the following is not a method of preserving fish (canning/smoking/marketing/salting?)

APPENDIX J

FOOD WEB (Form 1) Assessment

1. Explain how important food in the ecosystem is.
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2. Identify different predator/prey relationships that exist among living members of the tropical rain forest.
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3. Briefly explain how living things affect each other in an ecosystem.
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4. Give two differences between a food chain and a food web.

FOOD CHAIN	FOOD WEB

5. Mention any two protective mechanisms that plants employ to avoid predators.
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APPENDIX K

CARBON CYCLE (Form 2) Assessment

1. What is meant by the carbon cycle?

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2. Mention two importance of the carbon cycle.

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3. Mention five human activities which disrupt the flow of the carbon cycle.

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4. Explain how the disruption of the cycle affects the environment.

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5. Name two processes which releases carbon dioxide into the atmosphere, and a process which removes carbon dioxide.

APPENDIX L

Structure of Atoms (Form 2) Assessment

1. Name the sub-atomic particles in an atom and state the electrical charges on each of them.

2. Which of the following pairs of particles are both electrically neutral? A. Neutron and electron B. proton and neutron C. atom and neutron D. atom and proton).

3. A particle has an electronic configuration of 2, 8, 8 and 17 protons. The particle is likely to be a ……………………….. ion.

4. Draw the following atoms; helium, neon, argon.

4b. What can you say about the distribution of electrons on their outermost shells?
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…………………………………………………………………………………………………
………………4c. What general name is given to these atoms?
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5. Draw up the first part of the Periodic table the elements. For each of the first twenty elements, show its name, symbol and atomic number

APPENDIX M

QUESTIONNAIRE FOR STUDENTS IN THE ART INTERVENTION CLASSES 1&2

1. Drawings, diagrams and illustrations are used to make lessons in integrated science easier. (True/ false)

2. Mention the kinds of art usually used in teaching in the science class:
………

3. What kind of art do you like in the integrated science lesson? E.g. drawing, charts, building of models, illustrations from textbook etc.
…………………………………………………………………………………………………….

4. Do you enjoy the use of drawings, charts, real objects, models, jig-saw puzzles in your science class? (Yes/ No)

5. Are they useful in the lesson? (Yes/ No)

6. What do you gain from the use of art employed in the science lesson?
……

7. Do you think the non-use of the art such as the drawings; charts would give you the same level of understanding? (Yes/No)

8. Which of the following would you want your teacher to do?
a) To use drawings and diagrams in the teaching of integrated science where necessary.
b) To avoid the use of drawings and diagrams in the teaching of integrated science.
c) To leave the drawings and diagrams to only those students who have reading difficulty.

8b.Explainwhy………………………………………………………………………………
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9. List five topics in your science class which you enjoyed and understood?
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10. What made you enjoy or understand these lessons?
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11. Which three topics in integrated science did you not enjoy or understand?
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12. Why did you not understand these topics?

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13. Do you want your teacher to use talking to replace drawing in your integrated science lesson?

(Yes/ No)

14. Give a reason for your answer to question 13
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