

**INDIGENOUS LEATHER FOR THE PRODUCTION OF INSTRUCTIONAL
MATERIALS FOR NATURAL SCIENCE EDUCATION**

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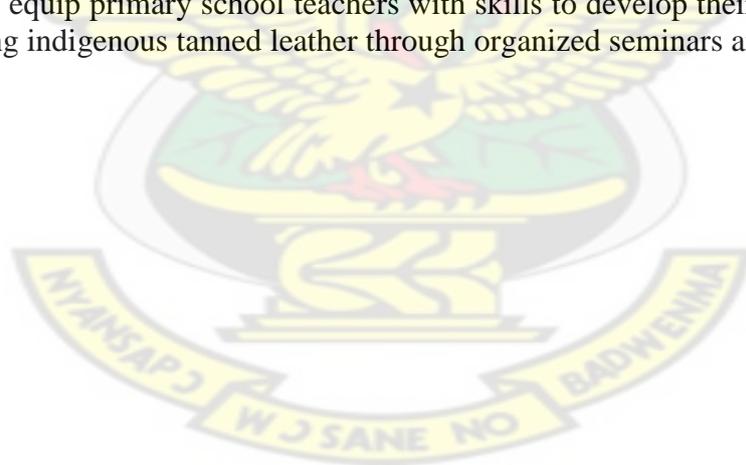
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ABSTRACT

Indigenous tanned leather is not usually used as a medium for the production of Instructional Materials; hence, it is unknown to the local Instructional Material makers. Since Science is one of the most important and compulsory subjects taught from Primary to the Senior High levels in Ghana, it is vital to make it real when teaching it to pupils. The study sought to document the existing Instructional Materials used for the teaching of Natural Science and analyze their impact on pupils' academic performance, in order to design, produce and test appropriate Instructional Materials (IMs) utilizing indigenous tanned leather on pupil's academic performance at Ahinsan M/A Primary 'B' School in Kumasi. The study embraced the qualitative research method, under which the case study and quasi-experimental research methods were used. It also made use of observations and interviews as instruments for data gathering in order to describe the use of existing Instructional Materials, the materials used for production, appropriateness of the material, as well as analyzed their impact on pupils' academic performance. The convenience and purposive sampling techniques were utilized in seeking data from 28 respondents, which included 26 pupils, 1 head teacher and 1 class teacher. The study revealed that the Instructional Materials that were produced made it easy for the teacher to teach lessons within a short period and had adequate time to assess pupils. Again, the lessons taught with the produced IMs were interactive and lively since pupils participated in class. Also, pupils were attentive and enjoyed the class because the lessons were not boring as compared to theoretical and abstract lessons which do not involve practical activities. Penultimately, the traditional noisy atmosphere made during lessons due to pupils' lack of concentration was mitigated since the attention of pupils was not distracted during lessons. All these impacted positively on the academic performance of the pupils. The researcher recommends that, the Ghana Education Service should collaborate with Art departments in the country to equip primary school teachers with skills to develop their own Instructional Materials using indigenous tanned leather through organized seminars and workshops.

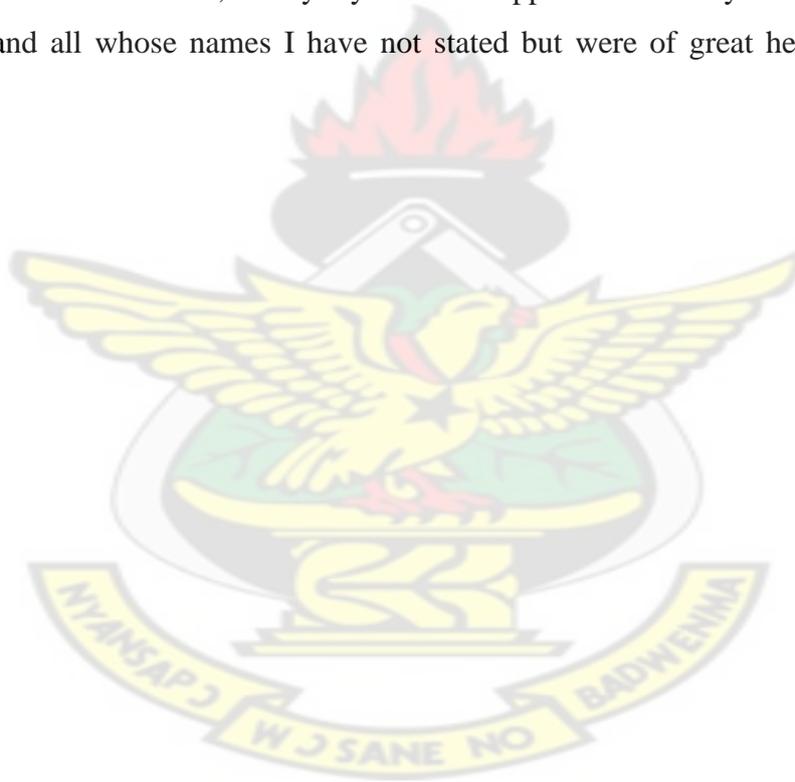


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DEDICATION

This project is dedicated to the Almighty God the Father, the Son and the Holy Spirit.

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CHAPTER ONE

INTRODUCTION

1.0 Overview

This chapter reflects the background to the study, statement of the problem, objectives of the study, research questions, delimitation, abbreviations, definitions of terms, importance of the study, and organization of the rest of text.

1.1 Background to the Study

In Ghana, Leatherwork has been an old occupation practiced over a century. The practice has gained recognition in the northern parts of the country and it spreads down through the Ashanti and Greater Accra regions. Fundamentally, the leatherwork industry produces leathers tanned by indigenous methods and techniques, and it is used in the production of leather artefacts such as bags, hats, sandals, belts among others, in order to serve both decorative and utilitarian needs of humanity (Asubonteng, 2010). Boahin (2013) describes leather as animal hide or skin that has been converted by chemical treatment and processing known as tanning. Tanning in Ghana is mostly made utilizing the vegetable tanning method in which plant extracts are used to convert the pelt into leather. Acacia nilotica (Bagaruwa) which is abundantly cultivated in the Northern region of Ghana is the local tanning agent used in the production of indigenous tanned leather; hence, most indigenous tanned leathers are produced there. Boahin (2008) postulates that, vegetable tanned leather exhibits unique characteristics in utility because of its diverse properties such as workability, durability, flexibility, adaptability as fabric or as hardened as wood and can be dyed into many colours. Moreover, he adds that the material can be manipulated into various forms and shapes; hence, making use of various form and decorative techniques in leatherwork such as embossing, tooling, carving and many more.

Among the several uses of leather, its engagement in the production of Instructional Materials is very limited or non-existing in Ghana (Anini, 2011). Therefore, the indigenous vegetable tanned leather used as a medium for the production of Instructional Materials is unknown to local Instructional Material producers. Effiong et al (2015) suggest that Instructional Materials are print and non-print items that are used to impart knowledge to students in the educational process. These include kits, textbooks, magazines, newspapers, pictures, videos, to mention a few. They further stated that Instructional Materials play a very significant role in the teaching and learning process.

That is, they enhance the memory level of the students and can appeal to the individual's attention by creating interesting goals that will help learners learn better. In support of this view, Oko (2011) articulates that the place of Instructional Materials among other teaching resources cannot be over-emphasized. This is because they dictate the methods or skills to be adopted in order to facilitate the achievement of teaching objectives. Broom (1973) as cited in Etsey (2005) also argues that the creative utilization of a range of instructional media increases the probability that pupils would learn more, retain better what they learn and increase their performance on the skills that they are expected to develop. Additionally, Ausubel (1973) as cited in Etsey (2005) agrees to the former by stating that pupils are able to comprehend abstract ideas if they are provided with adequate Instructional Materials and actual experiences with the topic that they are to understand.

Instructional Materials play an imperative role in the teaching and learning of Science. They tend to form the principal attraction point as they stimulate interest and promote a desire to learn. Also, they enhance explanation and help to describe words and processes by providing an accurate impression of a concept. Furthermore, Instructional Materials support retention, help to merge what has been learned to previous acquired knowledge, help to save teaching time and motivate pupils as they participate in Science lessons (Kothari, 2001 as cited in Wambui, 2013).

Science is one of the most important and compulsory subjects imparted to pupils from primary to students in the senior high level in Ghana. In order for pupils to climb the academic ladder, it is mandatory that they perform well in Science which is a fundamental requirement. According to the Oxford University Press (2017), Science is the intellectual and practical activity encompassing the systematic study of the structure and behavior of the physical and natural world through observation and experiment. Ameyaw-Akumfi (2004) points out that the foundation for the learning of Science and Mathematics is laid in primary schools, hence, Science must therefore be given greater emphasis at the primary school level. He adds that teachers in primary schools should be given effective preparation and support to enable them to provide exciting and fulfilling teaching and learning of Science and Mathematics. According to Maduabum (1991) as cited in Agudzeamegah (2014), Science must be made real to pupils in primary schools through appropriate teaching methods, thus, utilizing good Instructional Materials and improvisation where it is indispensable.

1.2 Statement of the Problem

According to Essel (2001), Instructional Materials are resources used to make teaching and learning effective. She added that these resources make the work of a teacher easier and pupils get the chance to learn readily. In support of this assertion, Alorvor (2010) also propounds that Instructional Materials are audio visual equipment needed for lessons in order to facilitate learning. In the light of this, Instructional Materials are very essential instruments that must be utilized in education at different stages of an individual's life. Children especially in the primary school and below need to be exposed to Instructional Materials in order for them to develop interest and enjoy so that they can remember items in a subject as it is being taught. An observation made by Agbadzi (2009) revealed that teachers who depend only on oral teaching find that their pupils are unable to relate their new learning effectively to any relevant previous experience.

Preliminary investigations made by the researcher at Ahinsan M/A Primary 'B' School revealed some weaknesses in the teaching and learning of Natural Science these include the following:

- Inadequate Instructional Materials were utilized for the teaching and learning of Natural Science. For instance, pupils were taught the subject with few charts and illustrations on the walls of the classroom and from the textbooks respectively during teaching and learning sessions.
- Pupils were taught in the abstract. That is, they were made to imagine some concepts in Natural Science, instead of the teacher showing Instructional Materials to help them comprehend what was being taught.
- The teaching of Natural Science was more teacher-centered than pupil-centered. Thus, the pupils contributed little as classes were in session. This made the transfer of knowledge slow and a little boring due to lack of Instructional Materials for teaching and learning.

The findings from the preliminary investigation have been buttressed by many authors and schools of thought. For instance, Gillespie (2007) suggests that children must be provided with as many instructional aids and models as possible when teaching Science. He adds that the learner-centered form of teaching that is, engaging children in the teaching process helps them to familiarize themselves with what is being taught and also gives them confidence to follow the lesson. The National Academy of Sciences (2017) also opines that learner-centered discussions or a collaborative learning method must be used in the

teaching of Science to ensure effective learning. The teaching and learning of Science should consist of pleasurable activities that appeal to the pupils' senses such as seeing, smelling and touching. Ineffective use of Instructional Materials like solid objects, textbooks, chalkboard and images for teaching Science discourages many pupils from learning and this leads to poor academic performance (Grossarchive.com, 2017). Asubonteng et al (2011) puts to light that, materials usually used in the production of Instructional Materials include, wood, clay, paper, plastic and Plaster of Paris. The materials may be too heavy as found in wood, easily perishable as found with paper and it is imported into the country accompanied with high charges. Anini (2011) in support of this states that metals are not recommendable for the production of Instructional Materials meant for children because of their weight, toxicity and tendency to injure children. Asubonteng et al (2016) suggest that wood is a local raw material that could be relied upon, however the rate of deforestation in the country does not make its source of supply adequate for article production.

In Ghana, the potentials of indigenous vegetable tanned leather have not been adequately exploited, despite its availability in large quantities. That is to say, about 80% of the raw materials used in the production of leather are eaten as meat by local people while the remaining 20% are converted into leather and used to produce articles (Asubonteng et al 2016). Additionally, local Instructional Material makers have not ventured to experiment with alternative uses of indigenous tanned leather beside what they already know like paper, therefore, indigenous tanned leather is limited to the production of containers, religious, household, sports, industrial and recreational artefacts, but there is more room for developing new ideas for indigenous vegetable tanned leather (Ntim, 2015; Asubonteng et al, 2016). Boahin (2008) affirms that, vegetable tanned leather displays distinctive properties that makes it suitable for the production of numerous products to meet man's need. Despite the functionality and availability of the raw materials in Ghana, none of the Instructional Materials found in the educational institution visited by the researcher were made of leather. In the light of this, the researcher finds it essential to explore the use of indigenous tanned leather for the production of Instructional Materials for Natural Science at the primary school level and establish their strengths and weaknesses on teaching and learning so as to create suitable Instructional Materials for a more interesting and effective Natural Science education.

1.3 Objectives of the Study

The study sought:

1. To identify the existing Instructional Materials used for the teaching of Natural Science and analyze their impact on pupils' academic performance at Ahinsan M/A Primary 'B' School in Kumasi.
2. To design and produce appropriate Instructional Materials using indigenous tanned leather for teaching and learning Natural Science at Ahinsan M/A Primary 'B' School in Kumasi.
3. To test the Instructional Materials produced for the teaching of Natural Science and evaluate their impact on pupils' academic performance at Ahinsan M/A Primary 'B' School in Kumasi.

1.4 Research Questions

1. What are the existing Instructional Materials used for teaching of Natural Science and their impact on pupils' academic performance at Ahinsan M/A Primary 'B' School?
2. How will appropriate Instructional Materials be designed and produced from indigenous tanned leather for the teaching and learning of Natural Science at Ahinsan M/A Primary 'B' School?
3. How will the produced Instructional Materials for the teaching of Natural Science impact on pupils' academic performance at Ahinsan M/A Primary 'B' School?

1.5 Delimitation

The study was limited to the designing and production of Instructional Materials from indigenous tanned leather for the teaching and learning of Natural Science for Primary Three pupils at Ahinsan M/A Primary 'B' School in the Kumasi Metropolis, Ashanti Region of Ghana. In addition, the Instructional Materials were produced for teaching and learning of the topics in Natural Science; namely, Sense Organs and Measurement of Time.

1.6 Abbreviations

- IM: Instructional Materials
- MOE: Ministry of Education

- GES: Ghana Education Service

1.7 Definition of Terms

- **Leather:** This indicates the animal skin or hide that has been treated with chemicals to make it withstand heat and decay.
- **Indigenous:** This refers to the characteristics of a particular group.
- **Vegetable tanned leather:** This is the leather that has been tanned using plant extracts, known as tannin or tannic acid.
- **Tan:** This refers to converting raw animal skin into leather.
- **Instructional Materials:** These are the teaching and learning aids that are used in classroom lessons to support specific teaching and learning objectives.

Instructional Materials (IM) and the term Teaching and Learning Materials (TLMs) are used interchangeably.

1.8 Importance of the Study

1. The outcome of study will be important to teachers and pupils since the use of indigenous tanned leather for producing Instructional Materials for Natural Science education in primary schools will make teaching and learning more interesting and effective; hence, increase academic performance of pupils.
2. The study will encourage teachers in Ghana to use available indigenous tanned leather as resource materials to produce Instructional Materials without relying on foreign resources in order to help pupils understand concepts taught in Natural Science.
3. It will also be beneficial to the Ministry of Education, particularly, the Ghana Education Service since the findings of this research will reduce the cost of imported Instructional Materials such as charts, plastics and electronically operated teaching materials that are foreign to Ghanaian pupils.
4. The findings of this study will be a repertoire of knowledge that will serve as a rudimental reference material for further studies by researchers and stakeholders in Art Education.

1.9 Organization of the Rest of Text

Chapter Two deals with both the theoretical and empirical deliberations of literature related to the use of indigenous tanned leather in the production of Instructional Materials in primary school. Chapter Three reflects on the research design, research methods, population studied, sample and sampling techniques, data collection instruments and procedures as well as the data analysis plan. Chapter Four presents the analysis of the main findings and the outline of the suggested design and production of the Instructional Materials. Chapter Five discusses the summary, conclusions and recommendations for the study.



CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.0 Overview

The related literature reviewed in this chapter were based on theoretical and empirical information for the study. The review is organized under the following main themes: primary school education, teaching, learning, science education, Instructional Materials, instructional design models and leather, to mention a few.

2.1 Primary Education in Ghana

Tuani (1990) suggests that education primarily must prepare individual pupils for their immediate environment, the society and the world at large. Hutchison (n.d) asserts that the Ministry of Education fundamentally oversees the educational system in Ghana. It is responsible for the formulation of educational goals at the national level. The ministry supervises the Ghana Education Service (GES), which is accountable for pre-tertiary levels of education. Opoku-Asare (2000) as cited in Siaw (2011) asserts that the educational system in Ghana is portrayed by uniform adoption of textbooks and blended ability teaching. In this sense, teaching is portrayed by the transmission of information; a model that takes its foundation in the traditional oral culture outside the school.

Ghanaweb (2017) affirms that the Ghanaian educational structure has evolved with time. The 6-3-3-4 educational structure signifying, 6 years of primary education, 3 years of Junior High School, 3 years of Senior High School and 4 years University course is now practiced in Ghana. Presently, about 18,530 primary schools have been built to facilitate teaching and learning in order to promote universal free primary education in Ghana, hence the government is supporting public schools with school fees, uniforms and free school feeding programmes. The primary school curriculum consists of Ghanaian Language and Culture, Mathematics, Natural Science, Religious and Moral Education, Physical Education, Creative Art and English Language which is the sole official language of instruction throughout the Ghanaian educational system with the exception of L1 (local language) in addition to English Language at the lower primary level. The primary school curriculum was developed in order to expose pupils to a wide range of ideas and skills that will aid them cope creatively with their environment. The Ladel Education and Health Organization (2013) as cited in Agudzeamegah (2014) promulgates the following

objectives of primary education as it is the rudiments of the educational system. These include:

- Setting the grounds for examination and creativity.
- Setting the grounds for the development of manipulatives and life skills that will develop individual pupils to perform effectively on their own.
- Development of pupil's ability to adapt constructively to a changing environment.
- Development of better ethical attitudes and a healthy appreciation of cultural heritage and identity of Ghana.
- Indoctrinating good citizenship education as a foundation for effective participation in national development.
- Numeracy and literacy education that is, the ability of pupils to count, use numbers, read, write and communicate effectively.

2.2 Teaching

Teaching is one of the most essential phenomena in formal education. People from varied walks of life understand this term differently. To some people teaching is just a profession while others perceive it as a way of moulding generation to come and shape the future (Duodu, 2002).

Alorvor (2010) describes teaching as the communication between a teacher and a pupil with the purpose of directing the pupil to acquire information and knowledge in order to develop dexterity or attitude which are compatible with their understanding, thus aid their total developmental growth. In conjunction to this, Fleming (1965) as cited in Duodu (2002) argues that teaching may occur in any situation in which a certain excess of skills or prestige prompts an individual to try and transfer to another person, something of his competence in knowledge, feeling, purpose or action. This signifies that apart from self-teaching, teaching in general normally occurs between two individuals; that is, the one teaching and the learner. Long (1968) suggests that the goal of teaching is to aid the learner to understand, assimilate and use the knowledge in the perception of man. He further adds that the teacher must be a mediator to the student in order to assist the birth of ideas and insight in the student.

Farrant (1996) as cited in Afum-Danso (2012) describes teaching as a process that facilitates learning. This includes building an environment to facilitate learning and

motivating learners to have interest in what is being transmitted to them. This means that what the students see, hear and do in the classroom is what the teacher provides for them, and what the learners are ready and able to learn. In conjunction to the above statement, teachers should make sure that, the content of the lesson is within the ability levels of the learners. Teaching should involve creating situations to simplify learning and motivate learners to be curious in what is being transmitted to them.

2.2.1 Good Teaching

Good teaching has a significant role of enhancing learning because within an educational system, it is the most prominent aspect that determines student outcomes. Good teaching affects the quality of student's achievement, involvement and participation in class lessons and also in social outcomes (Dorleku, 2013). Huze (2011) emphasizes that good teaching tackles and solves particular needs and develops the skills of pupils. In the light of this, teaching is made pleasurable and at the same time the interest of pupils is maintained during the teaching and learning process. Leblanc (1998) as cited in Afum-Danso, (2012) asserts the following as some of the requirements for good teaching:

- Students must be roused to learn. However they should be instructed on how to learn and it should be done in a way that is applicable, significant and noteworthy. It is tied in with looking after the educator's art, having an enthusiasm for it, and passing on that energy to everybody, in particular to the learners.
- Teachers must know the substance and regard students as patrons of knowledge. It is about doing your best to continue to excel in your field, reading sources, inside and outside of your specialized topics, and being at the top as frequently as one could expect under any circumstances
- There is the requirement for teachers to listen, question, be responsive, and recollect that each student and class is not the same. It is about pushing students to exceed expectations. At the same time, it is about being human, regarding others, and being proficient constantly.
- Good teaching is not continually having fixed schedules and being unbending, however it involves being adaptable, fluid, investigative, and having the certainty to respond and acclimate to evolving conditions.
- The style of introducing a lesson is also part of good teaching for teachers to adopt. The lesson must be engaging and interactive.

Clay (2001) as cited in Dorleku, (2013) clarifies that teaching is enhanced when teachers have a decent comprehension of, and are receptive to what the student's learning processes involved. Such learning procedures are, in general, specific to curriculum areas. Additionally, teaching is not a hypothetical demonstration that has universal application, but rather a very practical act that happens in particular classrooms with exceptional students. Teachers may draw upon guidelines of instruction as motivation in a diverse way but achievements in the classroom rely on the choices teachers make in view of their applied knowledge about teaching.

2.2.2 Teaching Methods

A teaching method is described as the process of controlling the cognitive activity of students, directed towards specific educational objectives. It also involves methods of stimulating, motivating and testing the activities of the student (Nikandrov, 1990). The term teaching method denotes the general ideologies, pedagogy and management strategies used for classroom instruction. The choice of teaching method is influenced by what fits the teacher's educational philosophy, topic area, classroom demography, and school mission statement (Teach Make a Difference, 2017). Ewing (2011) as cited in Dorleku (2013) asserts that teaching method refers to the mode in which the teacher gives knowledge or information to the learners, therefore, the teacher needs to employ several methods when delivering instructions in order to meet learners' different needs. Russell (1973) states that teaching methods should offer a clear and comprehensive statement of the educational objectives which are held for the learners. These objectives should be well-defined in terms of the behaviors that a successful learner would exhibit. He further argues that, the statement of objectives would help the teacher to focus and would inform the students of the expectations which are held for them. Long (1968) also submits that teaching methods must be mostly learner-centred, dynamic, creative and alive to end that personal growth of the student. Methods of teaching must be adopted based on the environment, familiarity of the situation or experience. Furthermore, the methods should differ from age group to age group and stage to stage (Seshaiah & Rao, 2004).

As cited in Ametordzi, et al., (2012), Kember (1997) posits that the means by which teaching is done are varied. Therefore, choosing a sound model that has a foundation in the discipline of education is one way to stimulate success. He additionally contends that merging models and utilizing various styles can make teaching and learning exhibit a

stimulating and compelling experience. Alorvor (2010) in agreement to the former states that teaching methods are mainly classified under two groups; namely, teacher-oriented methods and learner oriented methods. Under the teacher-oriented method is lecturing, questioning and discussion approaches. While the learner-oriented method includes role playing, field trips, discovery, class discussion, dramatic and project approaches. Other methods include demonstrations, experiments, note-giving, brainstorming, seminars and group work.

- **Demonstration Method of Teaching**

Afum-Danso (2012) proposes that the demonstration method of teaching is the process of teaching through trial or experiment. For instance, a Science teacher may instruct a lesson by executing an experiment for pupils. He further claims that a demonstration may be utilized to prove a fact through a blend of visual confirmation and related thinking. Also, demonstrations help to raise pupils' interest and strengthen memory maintenance since they provide association amongst certainties and true uses of those actualities. Child (2004) as cited in Dorleku (2013) believes the demonstration method of teaching provides students with the chance to express their views or sentiments orally on certain issues. This involves sharing thoughts and encounters, tackling issues and advancing resilience with comprehension.

- **Lecture Method of Teaching**

The lecture method of teaching denotes the teacher giving information to students while students remain latent listeners. The teacher delays for quite a while to welcome some questions from the students or give explanations. Lectures are often geared more towards actual presentation than connective learning (Afum-Danso, 2012). Huze (2011) claims that the lecture method can be used to deliver information that would have been difficult for the student to acquire. This is in the sense where students do not have the time requisite for research, or if reference materials are not available. Correspondingly, he contends that the lecture method enables the instructor to organize and present several thoughts or facts in a somewhat short time. This unquestionably makes the lecturing method the most economical of all teaching methods in terms of the allocated time necessary for a lesson.

- **Discussion Method**

The discussion method is normally utilized by a class to analyse information, to explain ideas and to answer problems. It is conducted using verbal comments, questions and answers piloted by the instructor as class members actively participate. Discussions can be frequently used amid the introduction phase of a lesson, before some other methods of presenting information. For discussions to be successful, the teacher must give the students points to consider ahead of time. In this sense, the learners proceed from the particular idea to the general thoughts (Huze, 2011).

- **Experimental Method**

Annor (1997) as cited in Huze (2011) suggests that the experimental teaching method is mostly used in teaching of the Sciences. In this case, the students are taught some principles and are allowed to try their hands on them; hence, as the students practice on their own they learn efficiently. Annor (1997) again believes that the experimental teaching method can be executed by the instructor for the benefit of the entire class or it can be performed by individuals or learners in small groups. Alorvor (2010) adds that the experimental method of teaching provides pupils with the opportunity for individualized instruction; hence, pupils are actively engaged and it boosts up their self-confidence.

- **Excursion/Field Trip Method**

Annor (1997) as claimed by Huze (2011) brings to light that a teacher can help students to learn by organizing trips or an excursion to a desired location of preference for recreation and seeing sites; it could be a visit to the museum or the market. With this kind of exposure, learners are made to have a practical feel of the world. Alorvor (2010) in agreement to this assertion states that, field trips help the teacher to link the real world to the classroom as it provides pupils with integrated experience.

- **Role-Play**

Alorvor (2010) contends that role-playing is a way of allowing learners to mimic people in a specified situation. He adds that role playing is a highly inspiring activity due to the fact that pupils learn through personal contribution and apply their learning in an appropriate, low risk situation. This assists and promotes the

pupils' collaboration, encourage empathy for others and improve social skills and values.

2.3 Learning

Learning can be described as “a process that leads to change, which occurs as a result of experience and increases the potential for improved performance and future learning” (Ambrose et al, 2010, p.3). The change in the learner may happen at the level of knowledge, attitude or behavior. As a result of learning, learners come to see concepts, ideas, and the world differently. Learning is not something done to students, but rather something students themselves do in order to interpret and respond to their experiences (http://www.queensu.ca/teachingandlearning/modules/students/04_what_is_learning.html) According to Schunk (2012), learning is the attaining and modification of knowledge, abilities, approaches, beliefs, attitudes and conducts. However, Houwer et al. (2013) see learning to be changes in behavior that result from experience or mechanistically as changes in the organism that result from experience. Hamer and Rebecca (2010) on the other hand argue that learning is equal to memorizing and the ability to reproduce what is memorized, usually in a school test setting.

Learning is one of the basic and central components of the distinctive activities that constitute the subject matter of psychology. The significance of all educational practices is to guarantee that students acquire certain abilities and act in a way that they had previously not behaved. This acquisition of abilities and attitudes that contribute to a change in behavior, which is the aim of education, is referred to as learning. Additionally, learning influences the perception, imagination, judgments, attitudes, thinking, personality traits, reasoning, systems of value, the development and organization of the activities that constitute the personality of an individual. The human skills, appreciations and reasoning in all their great variety, as well as human hopes, aspirations, attitudes, and values, are generally recognized to depend largely on the events called learning (Gagne, 1970 as cited in www.nti-nigeria.org).

Learning should not be restricted to being examined or observed as something that happens on an individual level. Instead, it is necessary to think of learning as a social activity concerning people, the things they use, the words they speak, the cultural context

they find themselves in, and the actions they take (Bransford, et al., 2006; Rogoff, 1998 as cited in Berkeley University of California, 2017).

2.3.1 Domains of Learning

Agudzeamegah (2014) believes that humans are lifetime learners; that, from the cradle we learn and absorb what we have just learned into what we previously know until one enters the grave. Learning can be categorized into the domains of concept knowledge, how we view ourselves as learners and the skills we need to engage in the activities. Although, there are various kinds or categories of learning, it is difficult to make a clear-cut classification as the individual categories tend to overlap with one another. According to Felder (2003) as cited in Ametordzi, et al., (2012), students implement different learning strategies. He suggests that 65% of students are visual learners (learn by viewing), 30% represent, auditory learners (learn by hearing) and 5% are kinesthetic learners (learn by performance).

Benjamin Bloom in 1956 (www.nti-nigeria.org) categorized learning into three major classifications that are:

- Cognitive learning which emphasizes the intellectual endowment such as learning of facts and problems-solving.
- Affective learning emphasizing development of attitudes and emotion; and
- Psychomotor learning which is concerned with skills development such as walking, writing, swimming, knitting, etc. These require the use of motor skills.

Giles et al (2003) as cited in Agbenatoo (2011) point out that each individual is born with certain preferences toward particular styles, but culture, experience, and development influence these preferences. Smith and Blake (2005) as cited in Agbenatoo (2011) identify five domains of learning. These include, informal, formal, incidental, situated learning and problem-based.

- Informal learning is not organized like the classroom situation but rather the learner embarks to learn something for himself. It is accomplished through perception; discourse with others, making inquiries, and notwithstanding committing errors and learning from them.
- Formal learning takes after educational programs and a succession of arranged instructing and learning exercises.
- Incidental learning occurs as the consequence of other activities.

- In situated learning, the knowledge learnt is utilized in the similar circumstance in which it is gained.
- With problem-based learning, activities are related with taking care of an issue. The set issue can be in a formal setting in order to bring about specific learning results, or the learning might be accomplished informally through working on a real life problem.

2.3.2 Learning Theories

Theories of learning are conceptual frameworks portraying how knowledge is consumed, prepared, and retained throughout learning. The Cognitive, emotional, and environmental impacts as well as previous experience, all influence in how learners understand or view things, acquire knowledge and skills and retain them (The Free Encyclopedia, 2017). Ertmer and Newby (2013) posit learning theories as a basis of confirmed instructional approaches, strategies or practices hand-picked for an effective remedy for tackling a specific instructional problem. They further suggest that there are three main theories of learning and these include behaviorism, constructivism and cognitivism.

- **Behaviourism**

In behaviourism, learning really happens when new behaviours or changes in behaviours are procured through associations amid stimuli and reactions. Hence, this association prompts an adjustment in behaviour (Ertmer & Newby, 2013). Zhou and Brown (2015) assert that the only behaviours deserving of study are those that can be witnessed directly; therefore, it is actions, rather than opinions or sentiments, which are the appropriate entity of study. Additionally, behaviourism does not clarify irregular conducts with regard to the mind or its internal workings but rather, it suggests that all behaviours are learnt lifestyles, and endeavours to explain how these lifestyles are formed.

In behaviourism, teaching does not prepare the learner for deciphering problems or critical thinking but dictates to learners what they are supposed to do as they do not hesitate to change or enhance things. In the light of this, the learner is only prepared for remembrance of fundamental actualities, programmed reactions or performing tasks

(<http://thepeakperformancecenter.com/educational-learning/learning/theories/>).

- **Cognitivism**

Cognitivism stresses on the attainment of knowledge and inward mental structures and all things considered nearer to the rationalist end of the epistemology field (Bower & Hilgard, 1981 as cited in Ertmer & Newby, 2013). With regard to cognitivism, learning is associated with distinct changes between conditions of knowledge as opposed to with changes in the likelihood of response. Cognitive theories emphasize on the conceptualization of students' learning procedures and tackles the issue of how information is acquired, sorted out, kept, and recovered by the mind (Ertmer & Newby, 2013). Taber (2011) attests that cognitivism enable learners to interpret what they see in meaningful ways because they can call on existing knowledge from which sense is attained due to past experience.

- **Constructivism**

Schunk (2012) indicates that constructivism deals with the learning process where individuals build new thoughts or concepts based on previous knowledge or experiences. In the light of this, individuals create particular mental models, which are used to understand their experiences. He further states that learning is basically the process of altering our mental models to oblige our new experiences. According to Applefield et al., (n.d), constructivism suggest that learners origination of knowledge are obtained from a meaning-making exploration in which learners participate in a process of building up their interpretations based on experiences. Furthermore, constructivism is an epistemological perspective of knowledge attainment accentuating knowledge development instead of knowledge transmission and the recording of information transferred by others. Schunk (2012) opines that constructivism concentrates on preparing learners to solve problem. Thus, to be productive, the learner needs a substantial base of knowledge upon which to interpret and generate ideas. Additionally, with constructivism, results are not always predictable because learners are developing their own knowledge. In this way constructivism does not work when the outcomes always need to be constant. In constructivism, individuals actively construct a meaningful interpretation of what is being heard or seen. Hence, pupils in class will comprehend things differently as its being taught. Constructivism suggests that effective learning has to be pupil-centered and teacher directed. Also, it informs the teacher that each learner needs time, space and a suitable experience to support the

learning process but with minimal guidance in order to bring out desired outcomes (Taber, 2011).

- **Humanism**

Parsons (2013) opines that the humanism learning theory attempts to address the learner's individual development. In this sense the learning is pupil-centred and personalized but must be facilitated by the teacher as he/she provides the pupil with a comfortable learning environment to equip the learner to build the self-esteem and confidence as the learner desires at his/her own pace and direction. Johnson (2012) is of the view that humanism learning assists learners to make personal connections to their lives, experiences, and emotions; hence, pupils learn more deeply.

2.4 Science Education in Ghana

The word "Science" when used without qualification can be deluding. In the light of this fact Science changes its tendency at the level where it is used. Science by and large involves the knowledge about elements, forces and methods in nature. The goal of Science education should be curiosity, compassion and competence; that is curiosity concerning the world we live in, compassion for those in need, and competence to make a move (Tuani, 1990). Ameyaw-Akumfi (2004) stresses that the basis for the learning of Science and Mathematics is laid in primary schools; hence, the youth in a science and technology propelled society will be required to be imaginative, communicate well, think critically, work supportively, discover answers to problems they experience, sustain their inspiration in the face of troubles and connect with people and ideas. Ameyaw-Akumfi (2004) adds that Science in this way should be given more prominent accentuation at the primary school level; teachers in primary schools ought to be given effective preparation and support to empower them to reinforce and provide exciting and satisfying teaching and learning of Science. The growth of children's thoughts is integral to Science education. Young children explore in Science activities with thoughts that they have fashioned from past encounters. They utilize these thoughts and concepts to comprehend things that occur around them. These thoughts have the tendency to be restricted to concrete, recognizable features and might be conflicting with the formal theories of conventional Science. With the concentration of Science education children will learn to adjust their thoughts and to grow more logical understandings as well as organizing. It is crucial to consider the

children's thoughts as the beginning stage for science activities and education (Agudzeamegah, 2014).

2.4.1 Challenges in Science Education in Ghana

National Development Planning Commission (NDPC) as cited in Ameyaw-Akumfi (2004) grieved about the low condition of science and technology in the nation, which has hindered the country's economic and social development. The identified challenges included:

- Inadequate resource allocation to science and mathematics teaching and learning at all levels of education, leading to poorly equipped laboratories and workshops;
- Inadequate government commitment to the development of science and technology;
- Poorly-developed science and technology innovation system; the lack of interaction among the different agencies connected with science and technology;
- Use of uncreative and old-fashioned approaches of teaching and learning in the schools e.g. chalk and talk approach, textbook dependent, examination-oriented teaching; learning through repetition remembrance (chew-pour-pass-forget), absence of Science practicals in most schools.
- Unmotivated teachers;
- Most primary and junior secondary school teachers are ill-prepared to teach science and mathematics;
- Post graduate research in science, technology and mathematics which should form the basis for developing the capacity for innovation and change is very low.

Ameyaw-Akumfi (2004) suggests that the solution to the country's development in the promotion of Science and Technology education especially at the pre-tertiary level is to promote the culture of innovation and change in our students. He adds that the promotion of Science education in the country will depend on three drivers of change, namely, funding, teaching and interventions and research.

2.4.2 Teaching Methods Employed for Teaching Science at Primary Schools

Teaching can be considered as an art people can learn but in the same vein there are people who are born teachers. The rudimentary goal of teaching any topic is to bring about a preferred change in behaviors of the learner. This change can be made possible by

adopting several appropriate methods of teaching. In the light of this the teacher must select and adopt the correct method of teaching with regard to the pupil's competence and the curriculum (Pattnaik, et al., nd).

Aina and Langenhoven (2015) postulate that the main teaching strategies employed in the teaching of science are the lecture and the demonstration method. They added that research has proven that lecture method of teaching science is not very effective especially with children. Bok (2006) and Berry (2008) as cited in Aina and Langenhoven (2015) opine that an average pupil retains only 42% of what he or she learns after a lecture method has been used and retains 20 percent a week later. Moreover they argue that the lecture method does not facilitate an active learning approach. According to Aina and Langenhoven (2015), the most appropriate teaching method for teaching science in the primary schools is the demonstration method because it enhances pupils understanding and increases their retention due to the use of manipulatives and lab experiments. Kusi (2017) affirms that though there are different methods of teaching, the pupil-centered method must be used in teaching science and this should involve a problem solving and decision making approaches as this helps them to participate and learn better. Summers (1994) posits that most primary school teachers lack the knowledge and understanding of science, hence, it is hindering the teaching of science in the primary schools.

Freire (2005) as cited in Kusi (2017) is of the view that the manner in which teachers prepare to teach science is based on their acquired knowledge and teaching skills. He adds that, bad teaching approaches utilized by teachers to teach science affects pupil's thoughts in the study of science, because they may perceive it as difficult subject. He concludes by stating that, in order to make pupils enjoy and contribute actively in class they should be provided with Instructional Materials to make them discover things or facts for themselves.

2.5 Instructional Materials

Instructional Materials are primarily a medium for accessing, manipulating and delivery of information that a teacher reiterates and builds upon. Instructional Materials may also be a variety of media, manipulative and supplies that are used to address the total needs of a child. These include meeting the cognitive, social, emotional, physical, and aesthetic needs of the child as a lesson is being taught. The primary objective of an Instructional Material

is to implement, enrich, and support the educational programme of the school system. This includes textbooks, pamphlets, magazines, software, charts, globes, maps, recordings, exhibits, and any other media of communication which may contribute to teaching and learning (Pasco County Schools, n.d; Chonjo et al, 1996 as cited in King'aru, 2014).

Effiong et al, (2015) suggest that Instructional Materials play a very essential role in the teaching and learning process. It enhances remembrance in pupils and can appeal to the individual attention by creating interesting goals that will help the learner achieve with direct effort. The need to emphasize on the use and importance of Instructional Materials in any learning and teaching environment cannot be underestimated because for any learning to take place, the teacher has to make use of these materials to enable him to teach effectively.

Craig (n.d) as cited in Anini (2011) states that a good Instructional Material is like a window. This should not call attention to itself but rather, should just let in light. He accentuates that Instructional Materials for children should:

- Attract attention
- Develop interest
- Adjust the learning climate and
- Promote acceptance of an idea.

Anini (2011) brings to light that, words project different meanings to different entities, but pictures, drawings, models and charts can elaborate effectively what we have in mind. Therefore, Instructional Materials are necessary to convey ideas and thoughts to the children to enhance their understanding in class sessions. Wambui (2013) postulates that the success of using Instructional Materials to meet the teaching objectives requires efficient use of the Instructional Materials and proper communication skills of the teacher to satisfy the instructional delivery. Joof (2005) as cited in Wambui (2013) explains that, the concept of Instructional Materials has gone through several evolutionary phases from the simple aids, instructional technology, and media to communication and educational technology. He further argues that, Instructional Materials are not just objects or apparatus used during teaching and learning process but they are objects improvised by the teacher to make conceptual thoughts more real and practical to the learners. Nkuuhe et al (1995) as cited in Agbadzi (2009) believe that every person learns by receiving information through the sense organs such as the ears, eyes, nose, tongue and skin. Hence, Instructional Materials must be used depending on what the teacher wants to achieve as

the learner is being exposed to the real world through the physical contact of the Instructional Materials. Kindler (1993) as cited in Chima (2017) states that people mainly remember; that is, 10% of what they read, 20% of what they hear, 30% of what they see, 50% of what they hear and see, 70% of what they say and 90% of what they say as they practice. Therefore, Instructional Materials assist learners pretty well to remember ideas or topics that were taught in class.

Harford and Baird (1997) as cited in Koranteng (2009) say that Instructional Materials transfer information more efficiently if teacher spends time to plan and design them. Harford et al believe that Instructional Materials used should reflect what exists in the learner's immediate environment. This will enhance students' learning if a well-balanced preparation is made for a particular task; thus, prescribing the correct medication and dosage to suit a particular medical problem. In the light of this, it has been observed that Instructional Materials contribute effectively to teaching and learning, since the learner does not only hear and see but also practices.

2.5.1 Types of Instructional Materials

The Free Online Dictionary (2017) perceives Instructional Materials as items being used to improve students' knowledge, abilities, and skills, to monitor their assimilation of information, and to contribute to their overall development and upbringing. Okogbuo (2000) as cited in Chima (2017) states that Instructional Materials can be classified into the following groups, namely;

- Visual materials: These include pictures, diagrams, charts, real objects, text books, newspapers, etc.
- Audio materials: These include tape recordings, radio, teachers' voice and others that appeal to the hearing.
- Audio visuals: They are materials such as television, video recordings, motion pictures and other that appeal to both the sense of hearing and sight.
- Software materials: These include power point slides, filmstrips and any item that cannot be touched but seen.
- Equipment/hard ware: these include printed out materials, flip charts, magnetic boards, etc.
- Electronics: These comprise of radio, computer, multimedia that makes teaching and learning more interesting and concrete.

- Non-projected materials: These include field trip simulation, games graphical materials, etc.
- Two-dimensional materials: These include flat pictures, charts, diagrams, slides, cartoons and others that have length and breadth but no height.
- Three-dimensional materials: These materials are solid and characterized by length, width and height.

Boafo (2010) and Fianu (1999) also propose that Instructional Materials generally come in two forms. These are visual and audio-visual. Moreover, they claim that visual Instructional Materials are items that exhibit graphical impressions, that is, items the learners just sees and understand during the lesson as they are taught. They include printed items, pictures, charts, three-dimensional objects and many more. Audio-visual Instructional Materials are those which do not rely solely on seeing to convey meaning but also transfer information through the hearing sense. These materials are used to appeal to different senses of an individual (Dike, 1993). Swank (2011) stresses that the efficacy of visual materials is inclining. He proposes that about 40% of teaching concepts are centred on visual experience, 25% based on auditory, 17% on tactile, 15% on various sensations and 3% on taste and smell. With the above declaration, it is obvious that audiovisual materials are significant in educational practices due to the fact that they combine different senses together to get thoughts clarified. Ngozi et, al. (2012) as cited in Ashaver and Igyuve, (2013) collectively concur that audio-visual materials are very essential and beneficial in teaching and learning because the normal learner gains more understanding through multiple impressions recorded by his sense organs , that is the eye, ear, skin and others. This is to say that, audio-visual materials do not only convey information to a specific sense organ but rather through a balanced distribution of information to other sensory organs for easy understanding by the learner.

2.5.2 Criteria for Selection of Instructional Materials

Instructional Materials (IMs) are very essential for effective teaching and learning but precautions have to be considered by the teacher or school when selecting these materials. The choice of Instructional Materials should satisfy the purpose and objectives of a lesson to be taught. An IM used in one lesson does not guarantee the transfer of the same message when used in another lesson. This suggests that there are specific roles that each IM plays in the teaching and learning process. Therefore, IMs if not properly chosen might

distort information for pupils instead of promoting understanding of a lesson being taught. There is therefore, the need for teachers to acquire various materials to satisfy the objectives of different lessons to be taught, understand their roles and more importantly get training on how to use them (Agudzeamegah, 2014).

Capangpangan (2017) claims that in the selection of Instructional Material it is advisable to look out for the following; functionality, aesthetics, economical, safety and hygienic requirements. Farrant (1996, p. 169) as cited in Agudzeamegah (2014) expounds that “good educational media are those that require the minimum of intervention by the teacher. Good Instructional Materials need little or no explanations, stimulate ideas, demand an active response from the learner, must be appropriate to the maturity and culture of the user as well as be flexible in use”. They should also provide enjoyment and must be durable. Alorvor (2010) suggests that Instructional Materials must help improve instructional delivery and learning, so they must be accurate, appropriate, bold and easy to use. He adds that in the selection of Instructional Materials, the following must be considered. These include; the learning objective, institutional constrains, the teacher, location, time and media worth level.

- **The Learning Objective**

A teacher must select an Instructional Material based on a specific learning objective as this will assist him to perceive the outcome of the lesson. If consideration of the objective for the learning is not attained before the Instructional Materials are selected, the effectiveness will be compromised.

- **Institutional Constrains**

Recourses and other educational constrains can limit the use of some Instructional Materials. Such constrains may include classroom connectivity, equipment availability and even beliefs of the stake holders in the school. In this case, the teacher should consider the constraints before selecting an appropriate Instructional Material for the lesson.

- **The Teacher**

The teachers’ philosophy of teaching and technological dexterity level is very essential; thus, the competency level of the teacher to use a specific Instructional Material. If a teacher selects any Instructional Material that he is not conversant with, he cannot use it efficiently and at the end he will limit the level at which he achieves learning outcomes for a lesson.

- **Location**

This has to do with the environment in which the Instructional Material is used. For example, a teacher cannot teach with an audio-related Instructional Material in a noisy environment. If this is done, the goal of the lesson will not or be partially achieved.

- **Time**

In teaching and learning situations, events may happen synchronously (happening at the same time) or asynchronously (happening in different times). In selecting an Instructional Material, the teacher must know the time at which the Instructional Material should be utilized. This will help the teacher to explain concepts properly and effectively with little effort.

- **Media-Worth Level**

A good Instructional Material must be able to appeal to most senses of the pupils. This will help satisfy the need of different pupils and also sustain their interest as the lesson goes on in class.

2.5.3 Importance and Uses of Instructional Materials

Horowitz (1992) as cited in Abgadzi (2009) posits that Instructional Materials function in different ways. These may include the former serving as means of recording events or situation, serving as an ancillary for a real object; a stand in, or symbol, communicating ideas or events, instructing and also functioning as a means of self-expression. Heinich et al and Okwudiba (n.d) as cited in (Chima, 2017) believe that Instructional Materials generally make teaching and learning an easy process. However, the former appreciates the significance of Instructional Materials as follows: They help to:

- Gain and hold the attention of the learner
- Provide visual aspects to a process or techniques
- Focus attention on highlight of key points
- Facilitate the understanding of abstract explanations
- Provide a common network of experience to large number of learners
- Stimulate reality and promote longer retention of knowledge of the learner
- Provide increased interest in learning
- Provide learners the opportunity to interact with the environment
- Offer learners the chance to do individual learning to develop their skills.

Agbadzi (2009) claims that Instructional Materials have great importance in teaching and learning because they permit easy and repeated reproduction of an event or process, provide graphical access to a process or technique, provide a common framework or experience to a large number of learners, promote the illusion of reality, gain and hold the attention of the learner, focus attention or highlight key points, save time by avoiding wordy explanation and also facilitates the understanding of abstract concepts. In conjunction to this Osuala (2010) as cited in Effiong et al, (2015) in his own contribution admits that Instructional Materials do not only help to motivate and develop interests on the part of the student, but also help to bring about an enhanced respect for teachers' knowledge of the subject. Effiong et al, (2015) believe that the effective use of Instructional Materials makes lesson presentations vitally fresh, stimulating and help the teacher to individualize the learning method as well as the content and also work according to the student's needs.

2.5.4 Appropriateness of an Instructional Material

Lunes (2015) affirms that Instructional Materials help pupils to create ideas in order that learning would be quicker and easier. Lunes believes that for an Instructional Material to be appropriate for pupils, first of all it should be made considering the level of the learner. Additionally it should be connected and applicable to the lesson to be taught and it should be clearly understood by the pupils. Moreover, some characteristics of an appropriate Instructional Material may include the size, hence, it must be made large enough for the farthest students in the classroom to see. Emelie (2009) opines that the attention of pupils are gained when Instructional Materials which are colourful and attractive are used in class as this help to facilitate learning process. In the sense of this bright colours must be used to produce the Instructional Materials. Emelie adds that durability of the Instructional Materials is a key factor since the Instructional Materials are not made for just one period only hence it must last if possible so that it can be reused. Lunes (2015) concludes in the note that appropriate Instructional Materials must be very portable and easy to handle, not injurious and very economical to produce.

2.5.5 Instructional Design Models

Instructional design models help instructional designers to make meaning of abstract learning theories and enable real life application. Instructional design models also provide a structure and meaning to an instructional design problem. There are many different

design models and several of them have common instructional design principles and patterns for solving problems. Some model designers have their models named after them and some based on the purpose they served. Examples include ADDIE (Analysis, Design, Develop, Implement and Evaluate), SAM model, Dick and Carey Model, Merrill's First Principle of Instruction, Kemp's Instructional Design Model, Gagne's Nine Events of Instruction, Bloom's Taxonomy, Kirkpatrick's Four Levels of Training Evaluation and so on (Central, Instructional Design, 2017). Educational Technology (2017) submits that instructional design models provide guiding principles to bring together appropriate pedagogical situations to achieve instructional goals. This can be made through practices of creating instructional experiences to help simplify learning most efficiently. In conjunction to this, Ryder (2012) as cited in Agudzeamegah (2014) posits that instructional design models help people in a way to understand an otherwise incomprehensible problem; thus they offer a structure and meaning to instructional design problems, permitting designers to deliberate design tasks with an appearance of conscious understanding. He additionally adds that visualizing a problem and breaking it down into separate and manageable units is attained with the help of instructional models; and the importance of a specific model is determined within the context of use.

2.5.6 Instructional Design Model Adopted for the Study

The instructional design model adapted for the study was the ADDIE model which represents Analysis, Design, Development, Implementation and Evaluation. Aldoobie (2015) suggests that the ADDIE instructional design model is a systematic procedure that aids designers in fashioning and developing operational, attractive, and effective Instructional Materials within an environment using science, art, learning and instructional theories. He adds that the instructional design model focuses on analyzing learners' problems and needs, designing of Instructional Materials, development of instructional objective in order to meet the learners' need, implementing the model, and finally evaluating the instruction on the learners and observing outcomes. Bates (2014) argues that the ADDIE model is one of the successful design models used worldwide because it is heavily linked with good quality designs, has cautiously structured content, clear learning objectives and evaluation tied with learning outcomes.

According to Aldoobie (2015), the ADDIE instructional design model has five phases that need to be adhered to, in order for designers to produce good Instructional Materials for learners. They include;

1. Analysis phase

The analysis phase deals with identifying all variables that are essential and need to be deliberated upon when designing an Instructional Material, for instance the learners' characteristics, resources available and learners' prior knowledge are all necessary points to consider in the analysis phase. This first phase in ADDIE is the most important stage as it helps the designer to determine the foundation for all future decisions. The analysis phase helps the designer to identify his target group, the learner objectives, limitations and opportunities, or other imperative points that will be beneficial in the design process. The Analysis phase tries to answer the following questions;

- Who is the learner and their characteristics?
- What is the expected behavioural outcome of learner?
- What types of learning constraints affect the learner?
- What are the delivery alternatives?
- What are the pedagogical considerations?
- How long will it take for the project to complete?

2. Design phase

This phase makes use of data collected in the analysis phase but it places emphasis on recognizing the learning objectives for the Instructional Materials and how they should be designed and produced. The design phase also identifies the areas that are to be captured in terms of text, audio and video and in which order it should be done. The design phase deals with the instructional designer brainstorming on how possible the needs of the learner can be met through assessment tools, lesson planning exercises, subject content, and media selection.

3. Developmental phase

This phase deals with the production of the Instructional Materials or the actual work. This phase solely relies on the first two phases that means, the development of items in this phase will be easier or difficult depending on how well the analysis and design phase was done. The stage involves the making of prototypes, developing materials for the course and testing to analyze the efficiency of the product made with regard to the learning objectives.

4. Implementation phase

This phase deals with the training of instructors and learners on how to use the Instructional Materials produced. The training is based on the learning objectives or the

course content, testing techniques, method of delivery and it involves the active participation of the learner and the facilitator.

5. Evaluation phase

The evaluation phase does not necessarily mean the last stage of the ADDIE model because discoveries made there can lead to the beginning of another process. With the help of feedbacks and data collected, the instructional designer is able to identify areas that needs improvement and works on it accordingly. The evaluation phase comprises of two parts; that is the formative and summative evaluation. In formative evaluation, tests are made at the end of each stage of the ADDIE process while the summative evaluation consists of tests made when the whole process or work is done. Some questions that may be answered during evaluation include:

1. Did learners enjoy benefit from the Instructional Materials?
2. Were the learning objectives attained at the end of the lesson?
3. Did the learners change their behaviours in the classroom at the end of the lesson?
4. Did the lesson achieve its instructional goals?

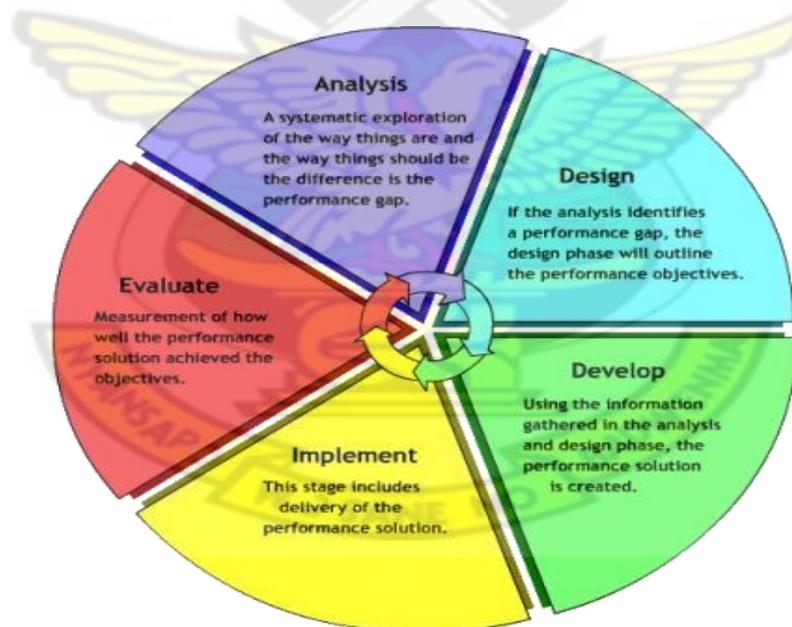


Figure 2.1: The ADDIE instructional design model

Source: (<https://www.bodhih.com/importance-of-addie-model-for-training/>)

From the instructional designs reviewed, the Design Framework for the Production of Instructional Materials with indigenous leather as the material was done adapting the ADDIE instructional design model. This model was modified a little but all the five phases were maintained and utilized. The phases include; Analysis, Design, Development,

Implementation and Evaluation. The researcher made use of the ADDIE instructional design model because it had a systematic procedure of developing and producing Instructional Materials and it was applicable in the line of the research. Below is the modified ADDIE model.

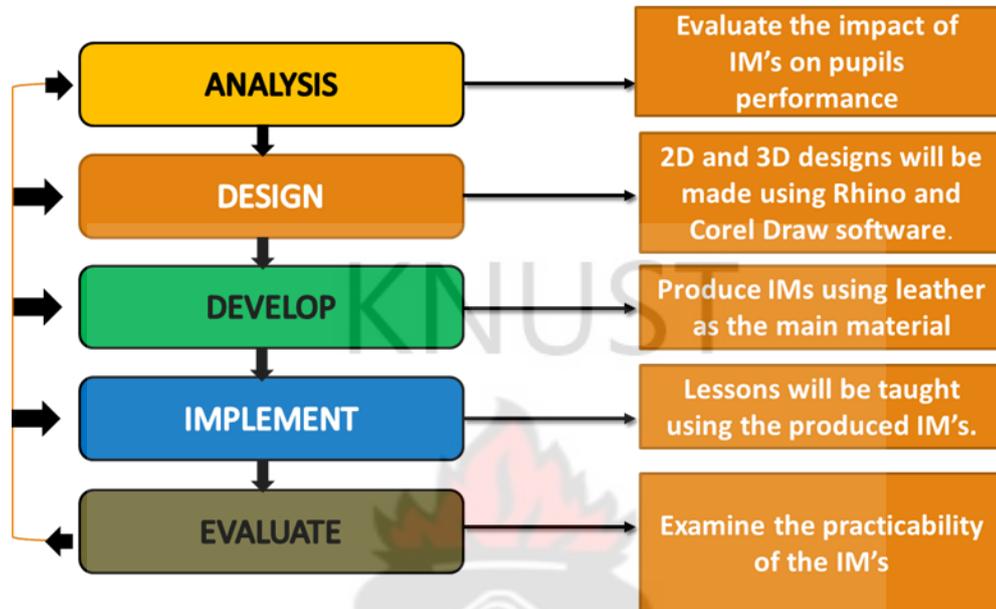


Figure 2.2: Modified ADDIE instructional design model

2.6 Leather

Boahin (2008) contends that leather making is one of the hoariest and popular indigenous vocations in Ghana and it is principally practiced in the northern part of the country. He believes that, the history of leather dates as far back as prehistoric era and the human desire to find an appropriate material to protect himself from the cruel weather conditions and injury brought about its production as varied generations of people have developed and improved different approaches of making it. Boahin further claims that leather is impervious to liquids but it allows gases or vapour to pass through due to the chemicals used in its production.

Leather has been given a number of definitions from different sources but fundamentally, it is a chemically treated organic material obtained from the outer covering of animals and are ready to be used (Andoh, 2015). Leather is seen to be animal hide or skin which has its original fibre structure more or less intact or tanned to resist decay and heat. The making of leather exists mainly to prevent skins from becoming dump, prevent putrefaction and enable flexibility and softness. The hair or wool on the pelt may be removed and the hide or skin may be split into layers before or after tanning (BLC Leather

Technology Centre, 2017). Boahin (2013) suggests that leather is made up of protein fibres which are mainly collagen and it is this collagen that is converted into leather by the tanning process. This provides the leather with physical properties such as elasticity, strength and durability. He further opines that leather has three main physical layers namely, epidermis, derma and hypodermis.

2.6.1 Vegetable Tanned Leather

Leather is acquired from animal skins and hides. Since the skins are susceptible to putrefaction, the development of requisite methods for stabilizing the raw animal hides, and making them more durable was necessary. This process is called tanning. Tanning can make leather exhibit different characteristics based on the tanning method used. There are three widely held types of tanning methods and these include chrome tanning, vegetable tanning and combination tanning (a mixture of chrome and the vegetable tanning (Matu, 2017). An ample attention will be given to the review of literature on vegetable tanned leather due to its importance to this study. Boahin (2008) explains that the name vegetable tanned leather is used often because the tannins and dyes used for tanning the leather are generally vegetable based. He further expounds that vegetable tanning is the most preferred tanning method because, it responds well to tooling and other decorative procedures. Ntim (2015) suggests that the vegetable tanning method is feasibly the most primitive method of converting animal pelts into leather with ingredients from the environment such as extracts from tree barks, leaves, seeds and roots. This treatment is introduced to pelts to improve its distinct properties and characteristics for the production of functional and decorative articles. Boahin (2008) contends that the tanning substances used vary from place to place and this is based on the tannin available in the vicinity; thus the leather showcases varied unique characteristics. Baidu (2015) claims that in Ghana especially in the northern region where most leathers are tanned, native tanners use tannins acquired from the pods of sumac tree (Acacia nilotica) locally known as “**BAGARUWA**”. The pods obtained from the plant is crushed in mortars, then leached with water to extract tannin for the tanning liquor. Tanning is then made by immersing pelts in a weaker tanning solution then finally transferred into stronger solutions. Matu (2017) suggests some advantages that accompany the usage of vegetable tanning technique of leather:

- Uses only natural ingredients; hence, it is environmental friendly and recyclable

- Vegetable tanned leather progresses with time and develops a patina of dark caramel color.
- The color of vegetable tanned leather is rich and warm.
- The look is completely natural and has a longer life expectancy.

2.6.2 Processing of Indigenous Vegetable Tanned Leather

Leather, just like any other material goes through several preparatory stages before it is used to produce an item. The Encyclopædia Britannica (2015) suggests that chemical treatment of raw animal hide or skin to convert it into leather is referred to as tanning. This process displaces water from the interstices between the protein fibres of the animal skin and cements these fibres together making it resilient. Boahin, (2005) states that the indigenous tanning process is not practiced the same way in all tanneries in Ghana. However, The Encyclopaedia Britannica (1977) as cited in Boahin (2005) outlines the three basic techniques utilized in the production of leather. These include:

- Removal of unwanted parts such as flesh, hair and fat tissues, leaving the compact network of high-protein collagen fibres, softened and hydrated. Boahin (2008) suggests that the process of removing unwanted parts of the skin before tanning is termed as the beam house operations. These operations condition the pelt properly for specific tanning types. They include soaking, liming, defleshing and dehairing, deliming, bating, degreasing, pickling and bailing.
- Tanning: That is converting the pelt with an agent, called tannin displaces water and then combines to coat the collagen fibres. Tannin enhances heat resistance, hydrolysis and resistance to micro-organisms. Boahin (2005) asserts that tannins are plant extracts leached for the purpose of vegetable tanning. These extracts are mixed with water and then pelts are immersed in it for tanning to take place. The tanning process may take a week or more depending on the thickness and state of the pelt.
- Leather finishing: This is done to obtain proper thickness, moisture content, lubrication and aesthetic appeal. Hence, the leather becomes a composition of animal skin combined with tannins, lesser quantities of oils, colorants, finishes and moisture. Boahin (2005) further opines that the finishing process includes drenching, currying, and dyeing.

2.6.3 Properties of Leather Necessary for the Production of Instructional Materials

Petersen (1961) as cited in Boahin (2008) opines that it is imperative to select the appropriate type of leather with the correct width and pliability for the production of an article. In the light of this, the researcher must know the characteristics and features of the leather to be used in the production of the Instructional Materials. Asubonteng (2010) as cited in Ntim (2015) affirms that the properties of leather differ significantly from leather to leather. This is dependent on the method of tanning employed and the quality of the raw material used. The chief properties of leather are exhibited based on the corium fibre network. This network consists of long undulating bundles of collagen fibrils in which tannins are fixed to increase hydrogen bonding between collagen molecules, these help make leather pliable. Further on, Boahin (2008) as cited in Gyebi-Agyapong et al, (2016) points out that vegetable tanned leather is adjustable in function due to its diverse properties, such as workability, malleability, elongation, adjustable as fabric or as toughened as wood and sometimes thick and magnificent. Leather has the ability to accept decorative procedures such as marbling, embossing and glazing and also has the feature that enables it to be dyed and polished until it has a lustrous finish. Due to this, the leather material has been employed in the production of varied range of products including shoes, apparel, bags and hats, just to mention a few (Boahin, 2005) as cited in (Anini, 2011). Asubonteng (2010) affirms that as leather is being used, it develops a staining color which enhances its beauty. He further claims that leather is breathable, insulating (can be cool or warm) and resists wet and dry abrasion.



CHAPTER THREE

METHODOLOGY

3.0 Overview

This chapter looks at the methods employed for the study. It explains the research design, research methods, sources where the data was obtained, experiments conducted and a description of the processes followed in the processing of the proposed Instructional Materials. It also assesses the suitability of the indigenous tanned leather in the production of Instructional Materials.

3.1 Research Design

Kothari (2004, p. 31) brings to light that “A research design is the arrangement of conditions for collection and analysis of data in a manner that aims to generalize the findings of the sample on the population”. He additionally confirms that the research design is the conceptual structure within which research is conducted; it constitutes the blueprint for the collection, measurement and analysis of data. Spector (1981) adds to the former as he claims that a research design is a strategy or structure that outlines the quantity and type of individuals or variable to be studied and their relationship to one another. Creswell (2014) believes that there are varied types of research design but yet, advances three basic divisions which include, the qualitative, quantitative and mixed methods.

Based on the practical nature of the study, the qualitative research design was adopted. The qualitative research is one of the main research paradigms, which encompasses the experiences, opinions and sentiments of people who are used to produce subjective data. It defines social phenomena as they occur naturally and attempts not to manipulate situations under study, thus, situations are just comprehended and explained from the participant’s point of view (Hancock, 2002 as cited in Agudzeamegah, 2014).

Creswell (2014) suggests that qualitative research design is utilized for exploring and understanding the significance people attribute to a social or human issue. These involve emerging inquiries and processes. Boakyewaa (2008) submits that qualitative research helps to describe the significance of a study; hence, when the study has insufficient information or when variables are unknown or when a theory relevant to the study is inadequate or absent, the qualitative research provides the essential areas to be studied in

such situations. Denzin and Lincoln (2005, p. 3) as cited in Atlas.ti (2017) describe qualitative research as involving "... an interpretive naturalistic approach to the world. This means that, qualitative researchers study things in their natural settings, attempting to make sense of or interpret phenomena in terms of the meanings people bring to them". Moreover, Ambert, et al. (1995) opine that qualitative research seeks depth rather than breadth of a problem; hence, it focuses on a representative sample of an entire population of interest and tries to seek or acquire in-depth information about them. Additionally, qualitative research helps researchers to learn about how and why people behave, think and make meaning as they do, rather than focusing on what people do or believe on a large scale.

- **Reasons for Adopting the Qualitative Research**

The qualitative research method was used in order to provide the researcher with in-depth information on available Instructional Materials and how they are utilized in the selected school. It was also fitting to use the qualitative research method since the study does not deal much with statistical processes of investigation. Moreover, the researcher adopted this approach because the problem being investigated was based on its natural setting, which is the classroom and environs of Ahinsan M/A Primary 'B' School. Furthermore, the qualitative research method permitted the researcher to find out the types of Instructional Materials used in the manufacturing of the existing Instructional Materials and how teachers use them together with how pupils interact with the IMs in the classroom for the teaching and learning of Natural Science.

3.1.1 Research Methods

Research methods allude to the conduct and instruments utilized in choosing and building a research procedure (Kothari, 2004). The researcher made use of the Case Study and Quasi- Experimental research methods under the qualitative research method. Gerring (2004) defines case study as an intensive study of a particular unit for the purpose of understanding a larger group with similar characteristics. Kothari (2004) in agreement to this opines that, case study research method involves a cautious and comprehensive observation of a social group, a person, an institution, or even the whole community. He adds that case study is mostly utilized when a detailed investigation of the particular entity is to be made. According to Stoecker (1991), case studies permit researchers to explore diverse outcomes of general processes proposed by theories depending on different

contexts, which suits public relations research that pursues application of theories to practice.

The case study research method assisted the researcher with an opportunity to observe and report a detailed account of the Instructional Materials available in the selected school, the materials they are made of and their uses in the teaching and learning of Natural Science.

The quasi-experimental research approach, according to wikipedia.org (2017), is a practical study used to assess the fundamental effects of an intervention on its population deprived of random assignment. Quasi-experimental research exhibits similarities with the normal experimental design but it lacks the component of random assignment to treatment or control. However, quasi-experimental designs permit the researcher to regulate the assignment to the treatment condition, but using some principle other than random assignment. Cook and Campbell (1979) as cited in Price, et al. (n.d.) submit that quasi-experimental research is mostly utilized to evaluate the efficacy of a treatment like an educational intervention. Since the independent variable is manipulated before the dependent variable is measured as this helps to reduce directional problems. In view of the above statements, the quasi-experimental research approach was used since it provided the researcher with the opportunity to explore indigenous tanned leather in the production of Instructional Materials as well as observe the use of the Instructional Materials and their effects on teaching and learning of Natural Science at Ahinsan M/A Primary 'B' School.

3.2 Population for the Study

Population in research generally refers to a large gathering of individuals and its main focus of a scientific investigation. It is for the benefit of the population that researches are done. Moreover, the population have related features; that is individuals in the group have an innate or common characteristic or trait (Explorable.com, 2017). The population for the study was made up of 2 head teachers, 7 teachers and 271 pupils in Ahinsan M/A Primary 'B' School. The population for the study therefore was $2+7+271= 280$.

3.2.1 Target Population

Target population also known as theoretical population basically refers to the total number of individuals to which researchers are interested in generalizing the conclusions. This type of population commonly has erratic characteristics (Explorable.com, 2017). The

target population was made up of a headmaster, 3 teachers and 78 pupils (26 pupils per class) in lower primary section of Ahinsan M/A Primary 'B' School. Therefore, the target population was $1+3+78 = 82$.

3.2.2 Accessible Population

The accessible population also known as the study population is a subset of the target population. It is the population in which the researcher can apply his or her conclusions based on investigations made. Also, sampling is made from the accessible population by the researcher (Explorable.com, 2017). The sum of the accessible population was maintained for the sample size because the number was manageable enough for the researcher to handle. Hence, the accessible population was made up of a headmaster, 1 teacher and 26 pupils. Therefore, the accessible population was $1+1+26 = 28$.

3.2.3 Sample and Sampling

Trochim (2006) describes sampling as the technique of selecting a suitable unit (individuals or groups) from a population of concern so that by examining the sample we may properly generalize our results back to the population from which they were selected. Mugo (2002) also suggests that sampling makes research relatively cheaper since the researcher has to observe a smaller entity rather than the whole. He adds that sampling helps the researcher to determine a population's characteristics quickly within the shortest time. The explorable.com (2017) sees a sample as simply being a subset of the population that is used to represent the whole gathering. The idea of sampling arises from the researcher's inability to examine all the individuals in a given population. Additionally, in sampling, the sample size of the population must be significant enough to warrant statistical analysis.

3.2.4 Sampling Design

Shapiro (2008) proposes that a sample design is the structure or road map that serves as the basis for the selection of a population which includes the sample and obtaining a specific type of information from them. Kothari (2004) states that the sample design also clarifies a number of items such as the size of the sample. He further claims that the sample design are varied and the researcher must select the one that is reliable and appropriate for his work. Also, it must be determined before data is collected. According to Amankwa (2002), there are broadly two types of sample designs and these include

probability sampling and non- probability sampling. Probability sampling is when the sample is selected in such a way that each element in the sample frame or population is given an equal chance to be chosen. They include, simple random sampling, systematic sampling, stratified sampling and cluster sampling. On the other hand, non-probability sampling is a type of sampling in which each element in the population has an unequal chance of being chosen. This is usually utilized under the qualitative research method and they include, purposive or judgmental sampling, quota sampling, convenience sampling and snowball sampling techniques. Based on the nature of this study, the convenience and purposive sampling techniques under the non- probability sampling design were engaged.

In convenience sampling as suggested by Amankwa (2002), respondents of the population are chosen for the study based on their relative availability. The convenience sampling technique was used in selecting the primary school for the study since the researcher had easy access to the school and this saved the researcher time and money from travelling a long distance to collect data. Amankwa (2002) posits that purposive sampling is done when respondents of the population are selected intentionally based on certain characteristics or qualities that meet the needs and requirements of the study. The purposive sampling technique was implemented to select teachers, head teachers and pupils since they had the necessary knowledge and information on Instructional Materials utilized in the school which was needed for the study. The sample size for the study was 28 which represented the accessible and target population.

3.3 Data Collection Instruments

Abawi (2013) suggests that data collection instruments are accurate and systematic approaches of collecting data for a research. In agreement to this Annum (2017) opines that data collection instruments are strategies used to find facts for a research and they include interview, observation and questionnaire, among others. He believes that, the reliability and validity of any research relies extensively on the instrument utilized; hence, it must be selected appropriately in order to bring out a dependable outcome. The researcher adopted interviews and observations as devices of data collection for the study based on the research method used.

3.3.1 Observation as a Tool for Gathering Data

Annum (2017) asserts that observation as a tool for gathering data, deals with the acquisition of first-hand comprehensive data especially in qualitative research by studying objects, activities and nature. Kothari (2004) affirms that with the observation instrument, information is sought after by the researcher's own direct surveillance of a situation without questioning respondents. He adds that this data collection instrument is free of biases and reports what is currently happening and it is independent of respondents, especially, when there is a verbal communications problem. The utilization of observation as a tool for gathering data enables the researcher to make use of all of their senses in order to investigate naturally occurring situations or people in their natural settings. Observations can be made in two main ways, these include the participant observation and non-participant observation (Cohen & Crabtree, 2006).

- **Justification for Choosing Observation as a Research Tool**

Observation as a tool for gathering data was utilized in order for the researcher to have a practical perception of how teaching and learning of Natural Science at the lower primary is organized at Ahinsan M/A Primary 'B' School. Moreover, the selected data gathering tool was used in order to identify the types of Instructional Materials available in the class, the topics taught and their objectives, how the teacher teaches lessons using Instructional Materials and how pupils respond to the Instructional Material, and their impact on the pupil's academic performance. Additionally, observation was used to perceive how pupils readily understood what the teacher was teaching since, they could not be interviewed.

For the sake of omissions of certain vital information because authorization was not approved for audio-visual recordings due to ethical consideration, it was essential to use observation as a supporting tool to gather data. The observation was scheduled in two parts: a total of three weeks classroom lesson observation were anticipated but six weeks were used due to various challenges from the school such as termination of arranged lessons due to interruptions in the academic calendar and postponement of lessons because tutors were absent from school for numerous reasons. Three weeks each of teaching and learning of Natural Science were observed in the first and second term of the school's academic calendar. Documented descriptions and still images were methods employed to gather data. An observation checklist was used to guide the researcher on what to look for.

- **Designing an Observation Checklist**

An observation checklist was developed to direct data collection throughout the participant observation process. Moreover, the checklist was developed based on the research objectives as this made it very easy. The checklist assisted the researcher to write down the necessary observed activities which went on in the classroom as the teacher taught the lessons. In order to ensure that the developed checklist was appropriate for data collection and was free from errors it was circulated for vetting among the researcher's colleagues from the Department of Educational Innovations in Science and Technology, for the necessary adjustments before it was submitted to the research supervisor for final vetting and approval.

3.3.2 Interview as a Tool for Gathering Data

According to Annum (2017), interviews are necessary when the researcher sees the need to meet face to face with respondents to interact and produce ideas that are of interest to the researcher. In this process, the researcher (interviewer) poses specific oral questions to the respondent (interviewee) then records the response. He further argues that in order to obtain detailed and relevant information from the respondent there must be a creation of good rapport between the interviewer and the interviewee. Abawi (2013) describes interview as simply asking people of concern relevant questions either on phone or in person. He also suggests that there are four types of interviews, these include: structured interview, semi-structured interview, in-depth interview and focused group discussion. Based on the nature of the study, the semi-structured interview was employed to search for answers to particular inquiries applicable to teaching and learning of Natural Science from the school head and teachers embracing the face to face approach. The researcher used a similar approach to accumulate data through perception of the environment. Both the school head and teachers were interviewed on Natural Science education, Instructional Materials and their perspectives on merging Instructional Materials for teaching Natural Science at the primary school level. A cordial atmosphere was created in order to make the respondents share information eagerly and participate with ease.

- **Designing Interview Guide**

In the development of interview guide, two sets of interview guides were made, that is, one for the teacher and the other for the head teacher. The two sets of interview guides emphasized on the processes involved in teaching and learning of

Natural Science and how Instructional Materials are prepared and used in the classroom. In order to ensure the reliability and error free interview guides, copies were circulated among the researcher's colleagues for vetting before they were submitted to the research supervisor for final vetting and validation. Moreover, advance communication was made with the interviewees to ease them of unnecessary stress and help them to prepare for the interview, hence, making them comfortable during the interview. The interview in conjunction with the observation helped the researcher to analyse concerns with regard to the teaching and learning of Natural Science and the adoption of Instructional Materials for teaching the subject in the school studied.

- **Conducting the Interviews**

After a week of observation in the classroom which became the fundamental study for the research, an appointment was booked at the convenience of the interviewees for the submission of the copies of the interview guide due to familiarity sake. A week later, a date was scheduled for the interview with the school head and the Primary Three class teacher. The interviews were made face-to-face making use of both the native language (Twi) and English Language for easy explanation and understanding of questions and responses. The researcher, knowing how uncertainties could prevail with regard to time, duly responded promptly to all scheduled times and dates. Employing the functionality of a phone, audio recordings were made to support written descriptions in order for the researcher not to omit any details of the interview.

- **Difficulties Encountered During the Interviews**

In as much as the copies of the interview guide were given out ahead of the scheduled date for the interviews, both the teacher and headmaster due to some personal reasons did not read through the guide and that made the interviews a bit slow and difficult. Additionally, with regard to ethical considerations, the teacher did not allow audio recording of his responses during the interview, hence, some questions were repeated in order to make sure all essential points were noted for documentation.

3.4 Source of Data

Research data according to University of Leicester (2017) is any documented factual material usually retained and acknowledged in any scientific establishment as essential to authenticate research outcomes. Hox and Boeije (2005) propose that there are two main sources of data and they are primary and secondary sources of data. Primary data refers to first-hand information or direct evidence relating to a subject under consideration while secondary data denotes interpretations or analysis made by people based on primary data that they have acquired. The primary data accumulated for this research consisted of field notes from witnessing classroom lessons of Natural Science and personal interviews with the teacher and head teacher at Ahinsan M/A Primary 'B' School. Secondary data were sourced from published and unpublished thesis, books, online documents, journals articles, school records and other relevant documents that were specifically, associated to the teaching and learning of Natural Science, development and use of Instructional Materials as well as leather.

3.5 Data Collection Processes

As necessary protocol demands, an introductory letter was requested from the Department of Educational Innovations in Science and Technology and presented to the head teacher and teachers of Ahinsan M/A Primary 'B' School explaining the objective of the research. Approval was then given by the school head and the researcher was introduced to the teachers in the school before the commencement of the research. The researcher had some trouble scheduling time with the school head and Primary

A three-week observation was made after all problems were rectified for the research to proceed. The observation focused on how the class teacher taught Natural Science and its impact on pupils' academic performance as well as the design and development of Instructional Materials from indigenous leather in classroom.

Classroom observations were conducted on Mondays and Fridays of the permitted weeks and each period lasted for forty minutes. The scheduled times for the observations differed depending on the period the teacher thought was right for teaching Natural Science. Three weeks of classroom observation were made in the first term, that is the months of November and December 2017, and another three weeks were made from January to February, 2018 in the second term according to the school's academic calendar. The

observation checklist helped in identifying problems relating to Instructional Materials with regard to Natural Science Education. Moreover, data gathered using the check list assisted the researcher in the designing and production of appropriate Instructional Materials made from indigenous leather. The participant observation approach was embraced during the classroom observation, as it assisted the researcher to witness how Natural Science topics are taught and also engaged the researcher in the activities in the classroom when lessons were in session.

3.6. Activities Undertaken for Objective One

Objective one was to identify the existing Instructional Materials used for teaching of Natural Science and analyze their impact on pupils' academic performance at Ahinsan M/A Primary 'B' School in Kumasi. This objective was satisfied with observations made on the teaching and learning of Natural Science and the interviews conducted with head teacher and class teacher. At this juncture, the ADDIE model was adopted in order to achieve the objectives set for the study.

3.6.1 Analysis Phase

This dealt with making of investigations about the materials used in making the existing Instructional Materials and how appropriate they are. Additionally, the impact the IMs had on the pupils in relation to academic performance was also observed. Moreover, the methods of teaching utilized by the teacher too was observed.

3.6.2 Observation of Lessons on the Topic 'Measurement of Time'

The pupils present during the lesson were 26 and the main topic was 'Diversity of Matter' under which Measurement of Time was taught. The learning objectives for the lesson were that the pupils should be able to tell the time on devices for telling time and identify devices for telling time.

The class teacher introduced the topic for the day by using a lesson she taught earlier which was Day and Night. Later, she asked the pupils how they can tell the time during day and night, and what devices are used to tell the time. The teacher employed illustrations on a manila card, identified some devices for telling time and also made use of an illustration on the chalk board to explain how the analogue clock hands worked and how to read the time from hour to minutes. Moreover, the teacher helped the pupils to

identify the hour hand, minute hand and the second hand of the clock using the chalk board illustration. The pupils were given Natural Science textbooks from which they saw other devices for telling time and from which they were told to draw a clock and indicate the time beneath as an assignment. During the lesson, most pupils found it easy telling time by the hour but had problems telling by the minutes when the teacher asked them to tell the time from the illustration on the chalkboard. Pupils seated at the back of the class were misbehaving and not paying attention to what was being taught; hence, the teacher had to request for a cane to attract their attention. Pupils did not pay attention because they could barely see what was illustrated on the board and Instructional Materials used were not interactive enough to sustain their attention. Plates 3.1 to 3.3 shown below indicate the materials used for teaching and learning of Measurement of Time.

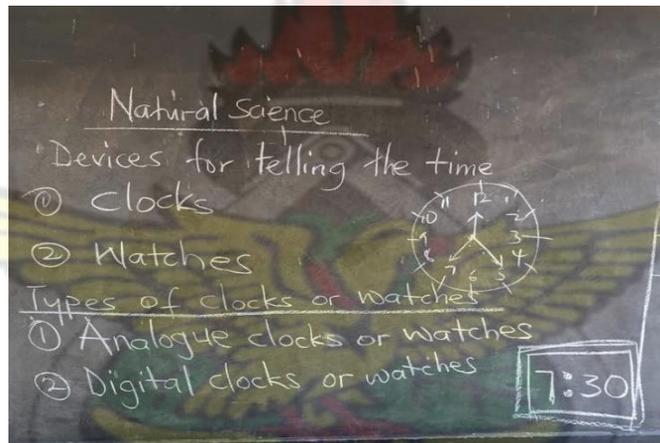


Plate 3.1: A chalk board text and illustrations



Plate 3.2: Illustrations on a manila card

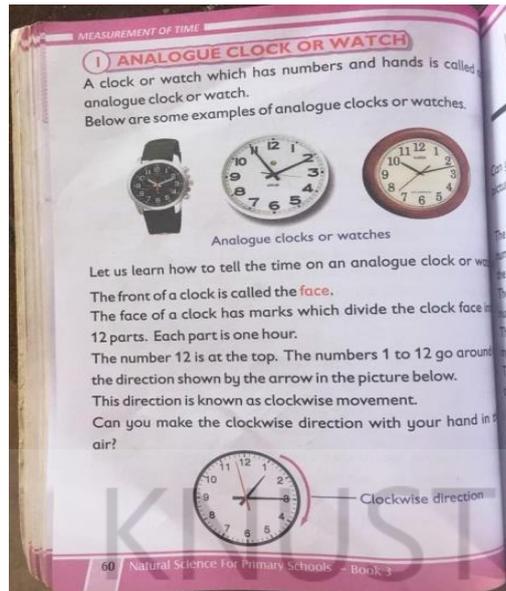


Plate 3.3: Illustrations in textbook for teaching Measurement of Time.



Plate 3.4: Most of the pupils were distracted during the teaching of Measurement of Time.

3.6.3 Observation of Lessons on “Sense Organs”

During the observation of this topic, 24 pupils present and the main topic taught was Systems under which Sense Organs was taught. The learning objectives were that pupils should be able to identify and demonstrate the functions of the sense organs on the human body.

The introduction of the lesson was done in the local language Twi which is termed as (L1) to help pupils understand what they are being taught. The class teacher introduced the topic by asking pupils what makes them see, hear, feel, taste and smell things in the environment. The pupils responded correctly and the teacher concluded that they are referred to as the sense organs that help people to perceive things in the environment. The

teacher then wrote the sense organs on the chalk board and asked the pupils to point at the sense organs on their bodies. Later the teacher used their bodies as realia for teaching the topic. Some of the pupils took advantage of this to misbehave and were not paying attention in class, so she went for her cane to call them to order as the lesson went on. With the help of the Natural Science text book, the teacher explained the use, importance and how to take care of sense organs one after the other. The pupils were then instructed to look into their Natural Science text book to draw and name the sense organs in their exercise books.

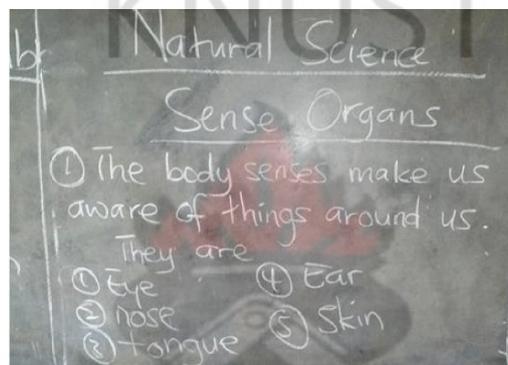


Plate 3.5: Identified Sense Organs written on the chalk board.

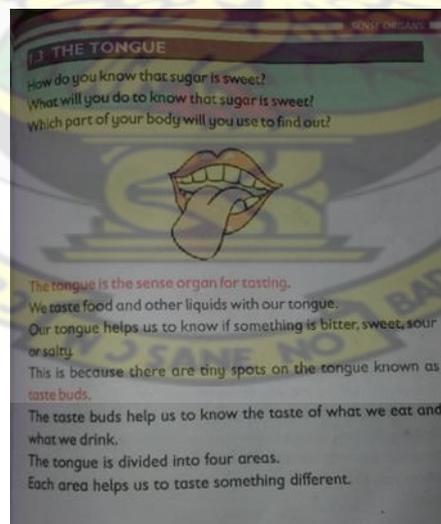


Plate 3.6: An illustration in a textbook on which pupils looked on to draw

3.6.4 Findings from Interviews with Teacher and Head Teacher of the School

The head teacher had a view that Science education is a practical lesson taught in schools and that it is very essential at the primary school level because pupils are exposed to new

things around them. He further said that the Natural Science taught in the school is mostly theoretical rather than practical, except that the teacher sometimes flash cards, pictures in textbooks or self-made illustrations on manila cards and chalk boards for demonstrations. The head teacher also stated that sometimes flip charts, textbooks, chalk and exercise books are supplied by the Ghana Education Service (GES) from the Ministry of Education normally at the beginning of a new academic year. From time to time, pencils and coloring tools were also supplied but these items are always not enough to benefit the population in the school.

The class teacher who has a post graduate degree and five years teaching experience in the primary school said she normally uses items in the environment or simple Instructional Materials made by herself. She is of the view that Instructional Materials are very necessary when teaching children because it sustains their interest during lessons and also helps them to understand concepts better.

3.6.5 Analysis the Impact of Existing Instructional Materials on Pupils' Academic Performance

In order to understand the influence the existing Instructional Materials made on the pupils academic performance. A test was made for the pupils with the help of the teacher. The test was set for both measurement of time and sense organs. This was done in order to realize whether the pupils understood what the teacher taught in class.



Plate 3.7: A section of the pupils writing a test after the lesson was taught.

The tests were supposed to be written by 26 pupils but some pupils were not present in school on the different days that they wrote the tests. Moreover, they were marked over 10 but the pass mark was 5. Below are the results showing the performance of the pupils after the lessons were taught.

3.6.5.1 Test Results for Measurement of Time

Out of the 26 pupils who were supposed to sit for the test, 24 were present. After marking the test, 7 pupils representing 27% of the total number of pupils had marks above 5, 17 pupils representing 65% had marks below 5 and two pupils representing 8% were absent. The outcome of the test clearly shows that, the majority of pupils in the class did not understand what was taught in class.

Results of test conducted after teaching Measurement of Time

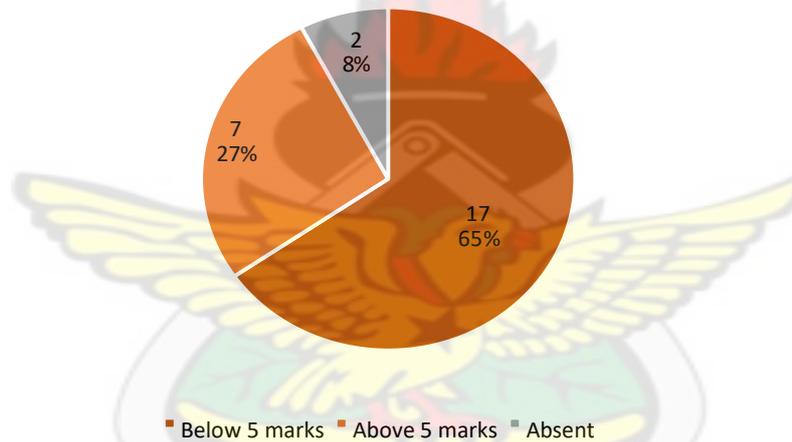


Figure 3.1: Chart showing results of test conducted after the teaching of Measurement of Time.

3.6.5.2 Test Results for Sense Organs

All 26 pupils were present during this test. After marking the test, 8 pupils representing 31% of them had marks above 5, 18 pupils representing 69% of the pupils had marks below 5. The outcome of this test also clearly shows that, the majority of pupils in the class did not understand what the teacher taught.

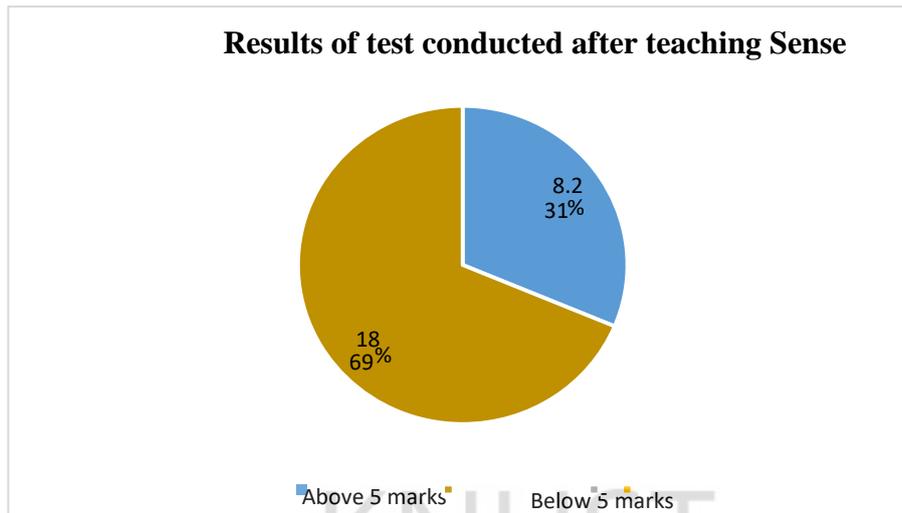


Figure 3.2: Chart showing results of test conducted after the teaching of Sense Organs

3.7 Activities Undertaken for Objective Two

Objective two sought to design and produce appropriate Instructional Materials utilizing indigenous tanned leather for teaching and learning of Natural Science at Ahinsan M/A Primary 'B' School in Kumasi.

3.7.1 Design Phase

This dealt with the designing of the Instructional Material models by the use of two and three-dimensional software. The designs were made to guide the researcher during the production and also provide an end view of the looks of the models after production.

3.7.2 Criteria for Designing of Instructional Materials

In order to produce appropriate Instructional Materials for teaching of Natural Science, it was necessary to develop a criterion and follow accordingly. Findings from observations and interviews from the selected school, together with secondary data obtained from books and the internet assisted the researcher to set a criterion for the designing and production of the proposed Instructional Materials and they include:

- a) **Durability of Instructional Material:** Due to how the Instructional Materials would be handled continuously by the teacher and the pupils during lessons, it was essential to use a material that is tough, hard wearing and strong. In the light of this, leather was suggested as a material for the production of the Instructional Material since Asubonteng (2010) affirms that leather has the characteristics to resist wet and dry abrasion, it lasts long and its beauty enhances as it is being used.

- b) Size of Instructional Material:** Emelie (2009) suggests that Instructional Materials must be made big or large enough to be seen by all pupils in a class. For this reason, the size of the Instructional Materials, the texts and digits were designed in a way that the last pupil seated at the back of the class could see clearly without difficulty.
- c) Color Scheme:** In order to make the IMs attractive to the pupils, sustain their interest and improve visibility from afar as Lunes (2015) proposes bright and complementary colors were suggested for the production of the different members of the Instructional Material.
- d) Safety:** The Instructional Materials were designed in a way that would not harm the pupils. Safety of the Instructional Materials was considered in terms of the friendliness of the material, size, heaviness and shape. Lunes (2015) believes that appropriate Instructional Materials must be easy to handle and not injurious to the user, especially, children.
- e) Portability:** The Instructional Materials were designed with the intention of making them easy for transporting or easy to handle and carry around conveniently without problems. Rongalerios (2009) in support of this view, suggests that Instructional Materials must not be made heavy to carry around or made too big to make transportation difficult.
- f) Target Group:** The Instructional Materials were designed with the primary pupils in mind. That is, the content of the IMs suit the level the pupils. The IMs were designed with a gamification concept, since children learn through playing. Moreover, the IMs were made using familiar words for easy understanding by the pupils. Lunes (2015) believes that for an Instructional Material to be appropriate for pupils, the kind of learners are to be considered. Additionally, it should be connected and applicable to the lesson to be taught and it should be clearly understood by the pupils.
- g) Simplicity and Suitability:** The Instructional Materials were designed in simple forms accompanied with visible and bold text and made purposely to attain the learning objectives of the lesson to be taught. Emelie (2009) affirms this as she posits that IMs should be simple, precise, informative and must target learning objectives.

3.7.3 Designing of Instructional Materials for Teaching Measurement of Time

The designs for the Instructional Materials for Measurement of Time were made in two dimensional forms. Two clocks were designed to show different display screens of a clock. One was made in an analogue form and the other was made in the digital form. Both clocks were made in a circular manner and rendered with bright colors to ensure attractiveness, simplicity and make it easy for the pupils to say the time.



Figure 3.3: Two dimensional designs of the analogue and digital clocks for teaching Measurement of Time.

3.7.4 Designing of Instructional Materials for Teaching Sense Organs

The designs for the Instructional Materials for sense organs were made in three dimensional forms. Each sense organ was designed separately in a high relief form and rendered appropriately to resemble the real ones. Five sense organs were modelled, they include; eye, nose, ear, skin (hand), and the tongue.



Figure 3.4: Three dimensional designs of human eye, nose, hand, tongue and ear which constitute the ‘Sense Organs’.

3.8 Development/ Production Phase

This step dealt with converting the designed Instructional Materials into real tangible objects. The production involved the identification of tools and materials together with the sequential production method and finishing processes used.

3.8.1 Processes Involved in the Production of IMs for Teaching Measurement of Time

- **Tools and Materials**

The tools used were cutter, needle, scissors, ruler, pencil, tack pins, single drive punch, wooden mallet, hammer, compass, glue brush, zinc plate, jig saw, a fid and an awl. The materials used were straw board, contact glue, super glue, white glue, leather, nylon thread, rivets, D-ring, paint (acrylic and auto base), leatherette and wax polish.

- **Production Process**

The initial step in this process was the treatment of the indigenous tanned leather. This process was very necessary in deodorizing the leather since it was produced utilizing very crude and archaic tanning procedure as this made the leathers to emit a pungent odour. The acquired leathers were laid on the table with the flesh side up, then sanding of the excess flesh was made using a 60 grit abrasive paper which was attached to a wooden block for easy use. The sanded leather was then soaked

in water mixed with lime juice to reduce the odour, remove dust and to make the leather flexible. Then. The leather was rinsed in clean water and stretched on a wooden board with the help of tack pins since this procedure helped to make the leather flat and wrinkle free. In order to prevent stiffness and grain breaks of the leather, it was dried under a shade in a well-ventilated area.



Plate 3.8: Sanding of leather



Plate 3.9: Soaking of leather



Plate 3.10: Stretched leather on the wooden board

The second step involved in the making of the digital and analogue clocks for Measurement of Time was the fact that both clocks were made in a circular manner. In the production process of the analogue clock, two sets of discs were cut from a straw board in which one was 57cm in diameter and the other 44cm in diameter respectively. A 2cm thick ring was also cut, positioned and glued at the edges of both discs to create a relief effect and also serve as a boarder for items within the work. The front side of a stretched leather was made moist and then glue was applied to the flesh side together with the face of the cut-out disc. It was then joined and air pockets were removed by pressing with a hard-smooth tool and the fingers. Glue was later applied to both discs and joined by placing the small disc in the bigger one. With the help of a compass, ruler and pencil, hour calibrations were made on the small disc while minute calibrations were made on the big disc. Rivets and cut-out numbers were fixed on the big disc to make the minute calibration visible. Big rivets were used for the minute markings and smaller rivets for the second markings. The digits used to represent the hour were made larger than the minute digits. Moreover, both digits were made to match the color of clock hand that corresponded to it, with the exception of the second clock hand which was made white.



Plate 3.11: Positioned small disc in the big disc



.Plate 3.12: Joined discs with rivet markings.

After the minute and hour numbers have been fixed the long clock hand with dimensions 28cm by 1.5cm and the short clock hands with dimensions 16cm by 1.5cm were also cut, sprayed and fixed on the face of the analogue clock.



Plate 3.13: Finished Analogue clock for teaching Measurement of Time.

In the production of the digital clock, straw boards of 44cm, 40cm and 37cm were marked and cut-out in a circular form to serve as a base then a rectangular sunken area with the dimension 29cm by 19cm was made in the middle to serve as the display face of the clock. The circular base was joined in a two-step manner in order to provide space for thonging and also enhance the beauty of the work. Glue was then applied to the flesh side of the indigenous treated leather together with the joined pattern of the straw board then it was bonded together. The edges of the clock were made moist, then with the help of a stamping tool ornamental designs were created for aesthetic purposes. Velcro was then measured, cut and attached to the middle portion of the clock to hold numbers that will be fixed there to display the time. Later, leatherette was attached to the back of the work using glue then punch holes were made at the extreme edges of the clock before thonging was made to permanently secure the edges and to enhance the work aesthetically. Four sets of numbers were cut out from the leather that has been reinforced with strawboard and leatherette. Two sets of numbers represented the hour and the remaining two represented minute digits on the clock. Both set of numbers were finished with color that corresponded to that of the analogue clock. This was made in order for pupils to identify them easily. Pieces of Velcro were cut and stitched at the back of the digital clock digits to allow for

easy attachment in the space provided at the display area of the digital clock. Both digital and analogue clocks were finished in a way that made it portable and easy to hang.

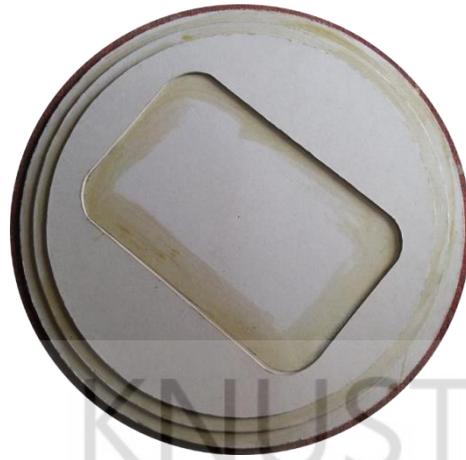


Plate 3.14: Cut-out and glued straw board with sunken middle part as the display area



Plate 3.15: Thonged digital clock with fixed Velcro in the front display area



Plate 3.16: Finished Digital clock with display numbers for teaching Measurement of Time.

3.8.2 Processes Involved in the Production of IMs for Teaching ‘Sense Organs’

- **Tools and Materials**

The tools used were abrasive paper, chisel, gauges, mortar, pestle, thumb pins, mould, pencil, squeegee, silk screen, rulers, sewing machine and brush. The materials used were leather, auto base paint, acrylic paints, thread, water, leatherette, straw board, contact adhesive, white glue, sand, leather side dressing oil and lacquer.

- **The Production Process**

In the production of the IMs for ‘Sense Organs’, the processes were divided into two main parts. These were the making of the moulds and picking of the moulds with leather together with finishing of the work.

- a. **Making of the Moulds**

Before the making of the moulds, beams of wood were sent to the saw mill for planing and cutting. The wood was cut in A4 sizes to ensure easy carving and produce models that will be visible from afar. The wood was then sent to the studio for further processing. With the help of marking tools such as pencils, drawing of the five sense organs were made on the front side or face of the wood. This was made bold and large enough to cover the entire surface of the wood. Using the chisel and gauges the unwanted parts of the wood were marked and chopped off leaving the positive part standing in a high relief form. The positive part of the wood was then shaped carefully to look like the sense organ in a real form. The carved model was later made smooth utilizing the abrasive paper to clear all unwanted chisel or gauge marks and dents.



Plate 3.17: The A4 sized wood cut from the beam.

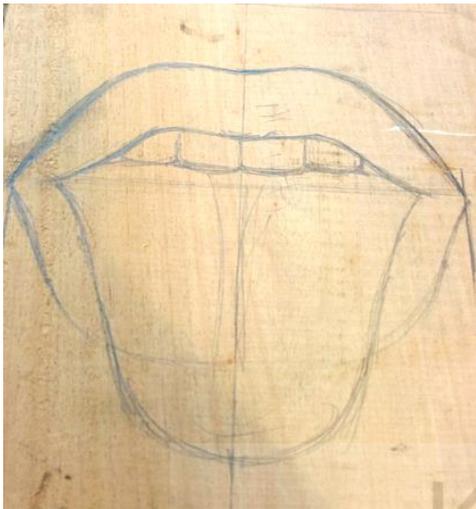


Plate 3.18a



Plate 3.18b



Plate 3.18c



Plate 3.18d



Plate 3.18e

Plates 3.18a to 3.18e: Drawn images of Sense Organs on the cut wood.



Plate 3.19: Sanding of carved models with abrasive paper.

b. Picking of the Mould with Leather and Finishing

After the moulds have been made, treated indigenous tanned leather was soaked in water and later pounded in a mortar with the help of a pestle. This was done in order to make the leather soft, stretchy and very flexible for modelling. The wooden moulds were placed on a flat board and the prepared leather in the wet state was wrapped around it. This was then worked upon to transfer the form of the mould into the leather. Thumb pins were used to hold leather in areas that needed to be worked on several times. The leather was then allowed to set and dry before burnishing was done to give lustre. After burnishing the leather was removed from the moulds and treated with white glue mixed with sand at the flesh side as a form of hardening the leather. The leather was then cut to size and reinforced with strawboard and leatherette utilizing the contact adhesive as a bonding agent. The edges of the models were marked and sewn to enhance the aesthetic appeal of the work and to ensure permanent bonding at the edges of the work. Rectangular slabs were also cut on leather and reinforced with strawboard and leatherette before sewing the edges. The slabs were used for labelling the functions of the sense organs.

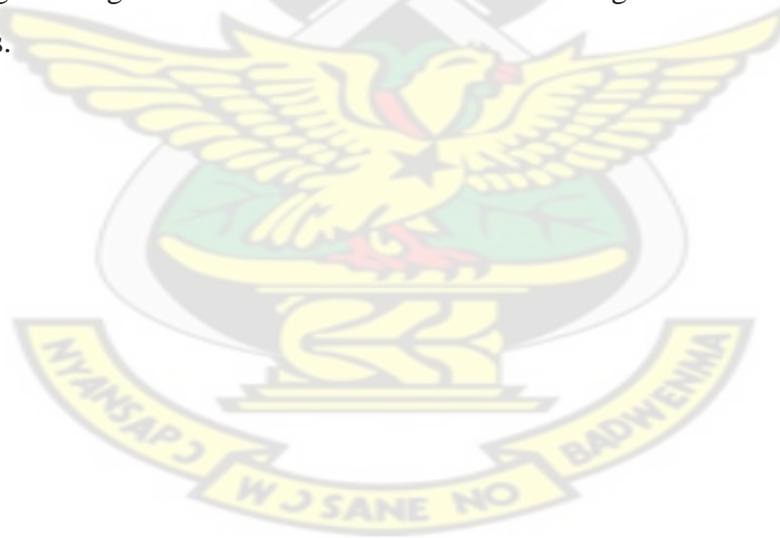




Plate 3.20: Leather modelled around moulds.

In the finishing process the sense organ models were painted with acrylic paints to make the model more real and solid, while the rectangular slabs were sprayed with auto base paints. They were printed with words indicating the functions of the sense organs. Finally, the works were treated with a neutral liquid polish to seal pores on the leather then it was sprayed with lacquer to protect the surface of the leather. The processes **a** and **b** were used in the production of all the five sense organ models including the second tongue which was used in telling different taste sensations.



Plate 3.21: The finished Sense Organ models with labelled slabs indicating their functions

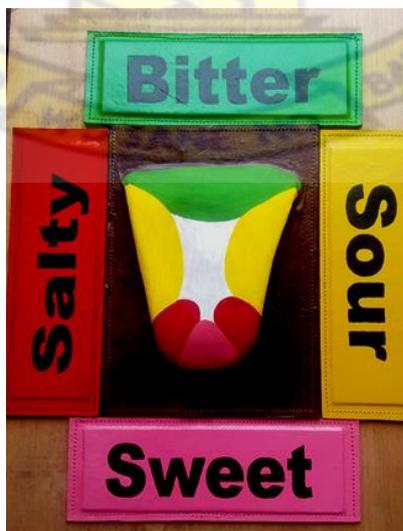


Plate 3.22: A modelled tongue indicating different taste senses.

CHAPTER FOUR

PRESENTATION AND DISCUSSION OF FINDINGS

4.0 Overview

This chapter focuses on the presentation and discussion of results as well as the findings made at Ahinsan M/A Primary 'B' School. The data gathered were used to design and produce Instructional Materials with indigenous leather and then tested in the classroom, after which findings were analyzed.

4.1 Profile of Ahinsan M/A Primary 'B' School

Ahinsan M/A Primary 'B' School is a government school which was established in 1954. It is located at Ahinsan, a suburb of Asokwa constituency in Kumasi, Ashanti Region. As at January 2018, the school had a population of 271 pupils (that is, 128 males and 143 females), 2 head teachers and 7 teachers summing up to 280. Each class in the school is made up of one stream with the exception of class six which has two streams and there is no kindergarten. The school is connected to the national electricity grid, has a pipe borne water and a fenced grass playing field. Additionally, the school building is constructed with cement blocks and aluminum roofing sheets with wooden doors and windows. The school has a dusty compound with no walls but it is rather surrounded by residential buildings.

4.2 Implementation Phase

This dealt with the testing of the produced Instructional Material in the primary 3 class of Ahinsan M/A Primary 'B' School. The test was done purposely to see the functionality and appropriateness of the produced Instructional Materials.

4.3 Activities Undertaken for Objective Three

Objective three was to test the produced Instructional Materials for the teaching of Natural Science and evaluate their impact on pupils' academic performance at Ahinsan M/A Primary 'B' School in Kumasi.

The produced Instructional Materials for Measurement of Time and Sense Organs were introduced to the teacher and was taught how to manipulate them in order to teach the topics effectively. The produced Instructional Materials were tested in the school to

establish their appropriateness, effectiveness so as to evaluate their impact on pupils' academic performance.

4.3.1 Testing of Instructional Materials for Teaching and Learning of Measurement of Time

The clock was tested in the Primary Three class at Ahinsan M/A Primary 'B' School. During the teaching of the lesson, the teacher first made some illustrations on the chalk board and then made use of the produced Instructional Materials to gain the full attention of the pupils in the class. Both the digital and the analogue clocks made exhibited bright colors, broad interface or display area, visible digits that are seen from afar and accessories that made them possible to hang. With regard to the analogue clock, the clock hands were made to match the corresponding digits, as this made telling the time easy. Pupils were made to interact with the clock by operating the hands of the clock, fixing and removing of digits on the digital clock to tell the time on the analogue clock. Additionally, pupils were made to partake in different activities that the teacher instructed to help them tell the time without difficulty.

The produced Analogue and Digital clocks had different display faces as this made it easy for pupils to identify the two main types of clocks used to tell time. Also, the numbering on both clocks were very visible; hence, the pupils did not have difficulty identifying the time as compared to the lesson taught at first without the Instructional Material. As pupils interacted with the clocks in a form of game, they understood the concept of telling time, knew the different clock interface and the teacher was able to achieve her objectives for the lesson and made the identification of figures easy (Emelie, 2010; Rongalerios, 2009). The brightly colored clock background, bold digits and visible clock hands improved visibility for pupils sitting at the back of the classroom.

The introduction of the produced Instructional Materials in class resulted in an atmosphere of euphoria. The pupils screamed with joy at the mere glance of the Instructional Materials and this act attracted the attention of other pupils to the class. Various pupils standing outside tried to peep through opened windows to see what was going on. As the teacher made use of the Instructional Materials in teaching the lesson, attentiveness, nods, and other gestures seen on the faces of nearly all pupils showed how eager they were to learn. Pupils were excited and yearning to be called to participate in different activities with the

Instructional Material. The class was very lively and when the teacher started asking questions, most of the pupils had their hands up in the air, including pupils who were not previously contributing in the class. The teacher was very surprised at her class being so lively and she exclaimed that it was the first time she saw her class in that manner.



Plate 4.1: Teacher demonstrating with Analogue clock during lesson in class



Plate 4.2: The teacher demonstrating with Digital clock during lesson in class



Plate 4.3: A pupil using Digital and Analogue clock to tell 'Time' during a lesson in the class

4.3.2 Testing of Instructional Materials for Teaching and Learning of Sense Organs

The Instructional Materials were tested in the Primary Three classroom. The Instructional Materials (thus, Eye, Ear, Two Tongues, Hand and Nose) were made realistic and they were big enough for all pupils to see from all corners of the classroom.

Additionally, leather slabs were made indicating the function of the sense organs. This was made to make the Instructional Material interactive as pupils could pick and match the sense organ to the function after the teacher has done a demonstration for the class to observe. One of the tongues was painted separately to show parts of the tongue that help us to taste different flavors of food. The tongue was accompanied with slabs having the same color as the area painted and an inscription indicating the taste experienced at that part of the tongue. All the models were made big enough and colorful, with bold and visible inscriptions on the slabs for easy understanding and identification by the pupils. The teacher introduced the topic by singing a song with the pupils in class. In the song, some parts of the human body were identified. Later, the teacher asked pupils to mention the parts of the human body that help them to perceive things around them. The teacher then introduced the Instructional Materials to the pupils by mentioning the parts and showing them the models of the parts made in leather. In order to make the lesson more interesting and engaging, the teacher invited two pupils to come forward and as one takes the model the other takes a slab with an inscription of the function that corresponds with it. Some of the pupils were directed by friends in order for them to pick the right slabs that corresponded with the chosen models. An example of the activities is seen in Plate 4.5.



Plate 4.4: Teacher demonstrating with the tongue as one of the Sense Organs.



Plate 4.5: Pupils showing the ear and its corresponding function to the class.

4.4 Evaluation Phase

The evaluation phase focused on the analysis of the impact of Instructional Materials on Pupil's Academic Performance with regard to both the existing and produced Instructional Materials. This was achieved by organizing tests for the pupils after a lesson has been taught with the Instructional Materials. Moreover, the evaluation phase revealed the strengths and weaknesses of the existing Instructional Materials for teaching and learning.

4.4.1 Strengths and Weaknesses Observed with the Use of Existing IMs for Teaching and Learning of Measurement of Time

- **Strengths**

The teacher employed chalkboard and textbook illustrations to introduce the topic to the class. Additionally, images in the class text books also provided the pupils with some notes and exercises to assess them. A self-made illustration on a manila card indicating both analogue and digital clocks for telling time were also used for the teaching of the Time.

- **Weaknesses**

Lunes (2015) affirms that appropriate Instructional Material must be made large enough for the farthest pupil in the classroom to see, but in this case the chalk board illustration made by the teacher was not that detailed, legible and big enough for the pupils seated at the back of the class to see clearly. Hence, this gave room for pupils at the back to misbehave as they had lost concentration. Moreover, the drawings on the board could not

be manipulated because it was two-dimensional therefore, it was quite difficult for the teacher to adopt them for practicals.

The self-made illustrations on the manila card was pasted at the left, back side of the class and this hindered the visibility of most pupils in the class as the pupils had to turn back to view the card. Also, the colors, lettering size and font style used for the Instructional Material was not appropriate because pupils had to strain their eyes to see what is written on the card.

In the light of these flaws identified, most of the pupils lost interest and did not pay attention in the classroom. Emelie (2009) affirms by stating that attention of pupils is gained and maintained when Instructional Materials used are colorful and attractive as these help to facilitate the learning process. In support of this assertion, Rongalerios (2009) that font sizes and font styles of Instructional Materials should be legible and bold for pupils to see without difficulty. The textbook used by the teacher and pupils did not provide sufficient practical activities on the topic. Hence, the IMs did not satisfy a basic feature according to Nikky (2010) as cited in Agudzeamegah (2014) who opines that Instructional Materials should help achieve learning objectives, must be informative and detailed for easy understanding.

4.4.2 Strengths and Weaknesses Observed with the Use of Existing IMs for Teaching and Learning of Sense Organs

- **Strengths**

The textbook, chalk board and realias the teacher used as IMs for the lesson helped in the introduction of the lesson. It also gave the pupils the opportunity to witness the environment practically. Moreover, the pupils had a pictorial view of the Sense Organs in their textbooks in which they looked on to reproduce in their exercise books.

- **Weaknesses**

The IMs employed for the lesson especially, the textbooks did not provide a practical experience for the pupils to engage in active learning. Also, a significant number of the text books had their leaflets torn out, making most of the pupils cluster around a text book resulting in noise making and class distraction. The teacher, in view of this, adopted realias but this further distracted the pupils' attention as they were not focusing on what the teacher was teaching but rather making fun of each other's sense organ. The above situation could have been avoided if appropriate Instructional Materials were used in the

teaching of the topic. Moreover, the realias used by the teacher were not big enough for the whole class to see as suggested by Emelie (2009), that Instructional Materials must be made big enough for the whole class to see.

4.4.3 Impact of the Produced Instructional Materials on Pupils' Academic Performance

After lessons have been taught using the produced Instructional Materials, the pupils wrote a test based on the topics taught. This was done in order to show the impact that the Instructional Materials had on pupils.



Plate 4.6: A section of pupils writing an assessment test after teaching with produced IMs.

- **Test Results for Measurement of Time**

Twenty-five (25) pupils were present during this test. After marking the test, 23 pupils representing 92% of the total pupils had marks above five (5). However, two (2) pupils representing 8% had marks below five (5). The outcome of the test clearly showed that, the majority of pupils in the class understood what the teacher taught using the produced Instructional Material for teaching and learning of Measurement of Time.

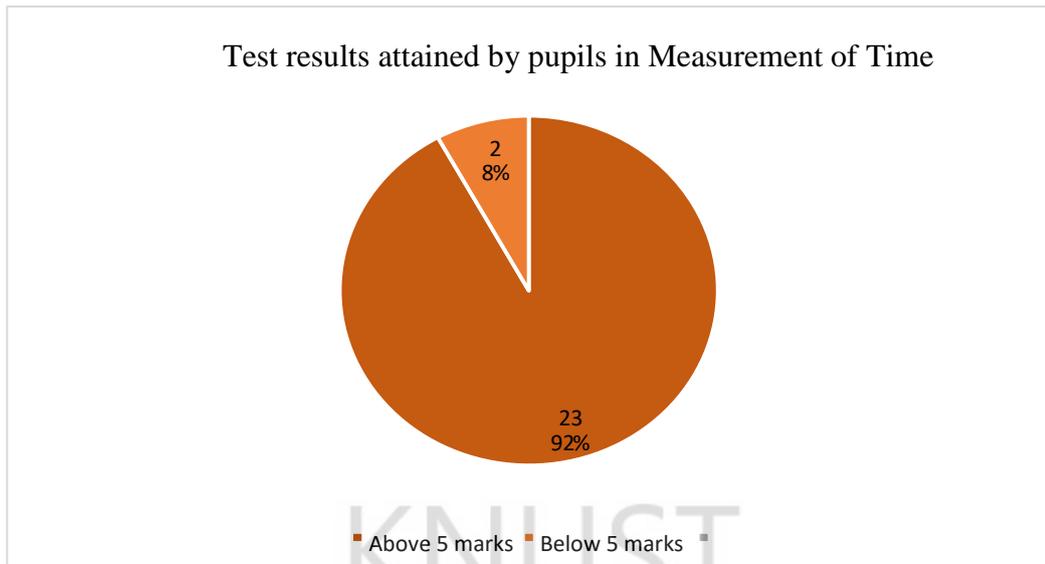


Figure 4.1: A chart showing results of test made for Measurement of Time after IMs have been used for teaching and learning.

- **Test Results for Sense Organs**

Twenty-five (25) pupils were present during this test. After marking, 21 pupils representing 84% of the total pupils' population had marks above five (5) whereas 4 of pupils representing 16% attained marks below five (5). The outcome of the test clearly showed that, the majority of pupils in the class understood what the teacher taught with the produced Instructional Materials.

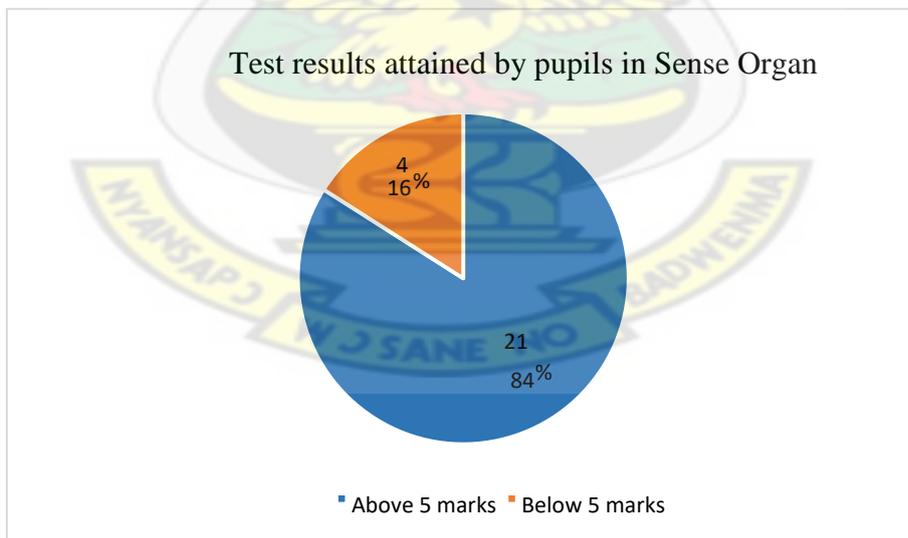


Figure 4.2: A chart showing results of test made for Sense Organs after IMs were used for teaching and learning.

4.4.4 Comparison of Test Results Before and After Use of Produced IMs for teaching and Learning of Both Topics

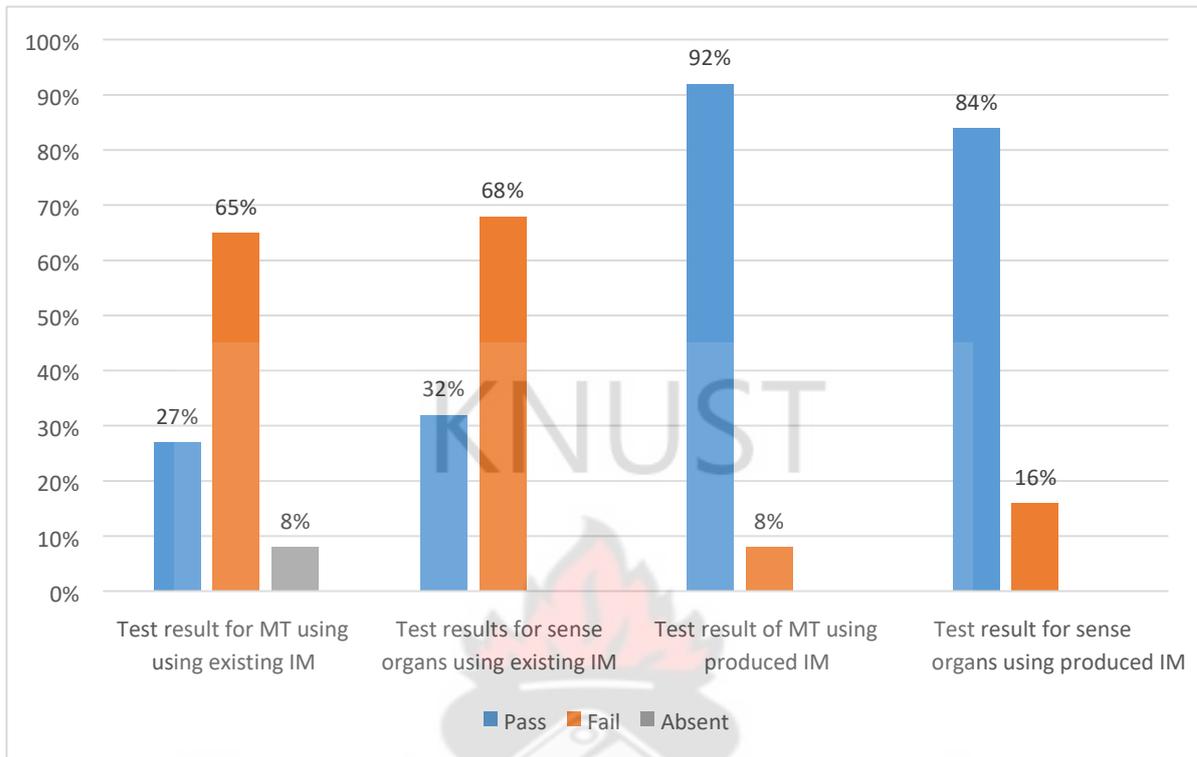


Fig. 4.3: Comparison of test results before and after the use of the produced IMs.

Results from the graph above showed that the performance of pupils before and after the use of the produced Instructional Materials. It was very evident that the existing Instructional Materials had less impact on the pupils' academic performance. On the other hand, the produced Instructional Materials had very positive impact on the pupils' academic performance since they were made appropriately to meet the qualities of a good Instructional Material and to meet the requirements of the objectives of the two lessons in Measurement of Time and Sense Organs. There was a 65% increase in pass mark for Measurement of Time and 52% increase in pass mark for Sense Organs. All these indications proved that when Instructional Materials are appropriately made and used in the teaching and learning of subjects that are taught to especially, pupils in the first cycle institutions, they will aid them to achieve higher academic excellence.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Overview

This chapter deals with the summary, conclusions and recommendations of the findings of the study.

5.1 Summary of the Study

This research was aimed at the employment of indigenous tanned leather for designing and producing of Instructional Materials for Natural Science education at the lower primary level using the Ahinsan M/A Primary 'B' School as a case study. The research was guided by objectives and they are:

1. To identify the existing Instructional Materials used for the teaching of Natural Science and analyze their impact on pupils' academic performance at Ahinsan M/A Primary 'B' School in Kumasi.
2. To design and produce appropriate Instructional Materials using indigenous tanned leather for teaching and learning of Natural Science at Ahinsan M/A Primary 'B' School in Kumasi.
3. To test the Instructional Materials produced for the teaching of Natural Science and evaluate their impact on pupils' academic performance at Ahinsan M/A Primary 'B' School in Kumasi.

The research engaged the qualitative research design under which the case study and quasi-experimental research methods were adopted. The case study research method gave the researcher the opportunity to observe in order to identify the existing Instructional Materials used by the teacher in class lessons while the quasi-experimental research method permitted the researcher to design, produce and test the Instructional Materials for in-depth analysis with regard to pupils' academic performance in the subjects.

Main Findings

1. The study made it known that, self-made charts, textbooks and chalkboard illustrations were the available Instructional Materials used for teaching and learning of Natural Science in the selected school, particularly, at the Primary Three classroom.
2. It was identified that the existing Instructional Materials used by the primary three class teacher were not very appropriate hence, they made it difficult for the teacher to explain and give practical examples for pupils to comprehend. In the light of this,

the pupils concentrated less in class; especially, those who were seated at the back of the class. This was so because the pupils could hardly see what was drawn on the chalk board or the illustrations made on the chart.

3. With regard to the analysis of pupil's academic performance, it was very evident that most of the pupils did not understand what the teacher taught in class hence, it brought about an abysmal performance by the pupils, in the sense that about 65% of the total population of the pupils had marks below the pass mark of five (5).
4. Data accumulated from the head teacher and class teacher assisted the researcher to establish findings that some topics were difficult to teach without Instructional Materials. The topics identified included Sense Organs and Measurement of Time. With the help of secondary data gathered from the internet and books, the researcher appropriately designed the Instructional Materials in two and three-dimensional forms. The production of the Instructional Materials was made from indigenous tanned leather as it was treated to remove odour, modelled and finished with colour to enhance their aesthetic appeal. All these procedures were guided by the use of a modified ADDIE instructional design model. The Instructional Materials were later sent to the class for testing their efficacy and the impact they had on pupils' academic performance.
5. On the issue of comparison of test results with regard to the existing and produced Instructional Materials for teaching the subject. It was evident that the use of the produced Instructional Material was appropriate since, pupils followed and understood what the teacher was teaching, and it reflected in the test as it revealed the improved performance of the pupils. The teacher was very excited in the use of the Instructional Materials since they made teaching and learning fun and easy, maintained the pupil's attention and helped them to understand what the teacher taught through the demonstrations with the produced Instructional Materials.

5.2 Conclusions

1. In as much as the research was conducted in one school in the Kumasi metropolis, it concluded the state of Science Education in many schools in Ghana. The act of teaching pupils in the abstract and not utilizing appropriate Instructional Materials for the teaching of Natural Science make the lessons boring and not interesting and it puts a burden on the pupils as they found it difficult to understand simple concepts during lessons.

2. Teachers also tend to brush over topics, leaving out salient points or skip certain aspects of the topic since they do not have appropriate Instructional Materials to help them express themselves more. The study concluded that charts, chalk board illustrations and the text book were the available Instructional Materials used for teaching Natural Science which were two-dimensional, thus, could not encourage manipulation to engage pupils.
3. The study also concluded that indigenous tanned leather has been limited to the production of slippers, bags and other body accessories even though it is readily available and its unique characteristics make it suitable for the production of other products. Identifying indigenous leather for the production of Instructional Materials will help the leatherwork industry open new avenues for the production of other items. Also, it will enhance the teaching of Natural Science and other subjects if it is used for the production of Instructional Materials.
4. The study additionally concluded that indigenous leather can be treated, manipulated and utilized to produce appropriate Instructional Materials for teaching of Natural Science for primary schools, if the designing and production is guided by a good instructional design model such as the ADDIE instructional design model.
5. Last but not the least, the study concluded that the use of appropriate Instructional Materials helped the pupils to concentrate more, understand what is being taught in class and this supports to improve on their academic performance since it leads the pupils to attain greater academic success. Moreover the use of appropriate Instructional Materials eases the teacher's burden during teaching of difficult topics as it makes the lesson interesting and fun.

5.3 Recommendations

The following are suggested recommendations that can help resolve and enhance conditions for the teaching and learning of Natural Science in Ghanaian primary schools:

1. Colleges of Education should integrate Instructional Material production techniques into their syllabus, to expose teacher trainees to a wide variety of local materials and help them to design and produce appropriate Instructional Materials for teaching and learning of subjects at the primary level of education.

2. The Ghana Education Services should ensure regular monitoring of school activities with regard to teachers implementing appropriate teaching methods in Natural Science education at the lower primary schools.
3. The Ghana Education Service should collaborate with Art departments such as the Department of Integrated Rural Art and Industry in order to organize workshops and seminars for primary school teachers, to develop their knowledge and skills of using indigenous tanned leather and other complementary materials for making of IMs.
4. Local leather workers should venture into the production of appropriate Instructional Materials as a means of finding other uses of leather and also to make teaching and learning fun, interesting, less stressful and enjoyable by primary school pupils in all subjects including Natural Science.
5. The government must help in the promotion of made in Ghana products by giving contracts to local craftsmen to produce Instructional Materials instead of importing them at high charges and of a lesser quality in order to promote national development.



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APPENDICES

APPENDIX A

INTERVIEW GUIDE FOR THE CLASS TEACHER ON INDIGENOUS LEATHER FOR THE PRODUCTION OF INSTRUCTIONAL MATERIALS FOR NATURAL SCIENCE EDUCATION AT AHINSAN PRIMARY SCHOOL IN KUMASI METROPOLIS

Part A: School's Information

- School's Name:
- School's Location:
- Classification of School: (a) Private [] (b) Government []

Teacher's Background Information

- i) **Sex:** (a) Male [] (b) Female []
- ii) **Age:** (a) Below 30 [] (b) Between 30 and 35 years []
(c) Between 36 and 40 years [] (c) Between 41 and 45 years []
(d) Between 46 and 50 years [] (e) Between 51 and 55 years []
Above 56 years []

iii) Qualification of Teacher:

- (a) Bachelor / Post-Graduate Degree [] (b) Higher National Diploma (HND) []
(c) GCE "A" Levels [] (d) Diploma in Basic Education (DBE) []
(f) GCE "O" Levels []
If others, please specify.

iv) Years of teaching experience:

- (a) Between 1 and 5years [] (b) Between 6 and 10years []
(c) Between 11 and 15years [] (d) 16years and above []

v) Years of teaching at the Lower Primary School:

- (a) Between 1 and 5years [] (b) Between 6 and 10years []
(c) Between 11 and 15years [] (d) 16years and above []

Part B: Questions

1. In teaching Natural Science, which teaching methods do you use?
(a) Lecture Method [] (b) Discussion Method []
(c) Field trip Method [] (d) Demonstration []
 If others, please specify
2. Do you use Instructional Materials (IMs)? (a) Yes [] (b) No []
ii. If Yes to above question, which type(s) of IMs do you use for teaching Science to pupils?
(a) Purchased (b) Locally made (c) Self-made
 If others, please specify.
- b. If No to Question 2, what strategies do you use in teaching Natural Science?
.....
3. Who provides IMs for your classroom for teaching Science?
4. Are the needed IMs available for use in the classroom? a) Yes b) No
5. What materials are the IMs that you use in your class made of?
6. i) Are the available IMs used appropriate for teaching Natural Science at the primary School? (a) Yes (b) No
ii) Please state the reason(s) for your answer
7. What IMs are available for pupils to learn privately or on their own?
.....
8. How do pupils in your class respond to the teaching of Science with/without IMs?
(a) Pupils participate in class [] (b) Pupils answer questions correctly []
(c) Pupils demonstrate understanding [] (d) Pupils pay attention []
(e) Pupils fidget in the classroom [] (f) Pupils sleep in the classroom []
(i) Please specify if others
9. Please kindly state why you think the above reason holds.
10. How do you sustain pupils' interest or get their attention in the classroom in the absence of IMs?
11. a. Can you state topics which are difficult to teach in absence of IMs?
.....
b. Please give your reason(s) for the above answer.
12. a. Are there other topics that are difficult to teach even with the use of IMs?
.....
b. Please give your reason(s) for the above answer.

APPENDIX B

INTERVIEW GUIDE FOR HEAD TEACHER ON INDIGENOUS LEATHER FOR THE PRODUCTION OF INSTRUCTIONAL MATERIALS FOR NATURAL SCIENCE EDUCATION AT AHINSAN PRIMARY SCHOOL IN KUMASI METROPOLIS.

School's Information

- School's Name:
- School's Location:
- Classification of School: (a) Private [] (b) Government []

Head teacher's Background Information

- i) **Sex:** (a) Male [] (b) Female []
- ii) **Age:** (a) Between 25 and 35years [] (b) Between 36 and 46years []
(c) Between 47 and 55years [] (d) Between 56 and

above []

1. a. As school head what is your view on science education in Ghana, generally?

b. Your view on Natural Science education in primary schools?

..... 2. How is the teaching and learning of science administered in your school?

3. How do you recruit your science teachers and what are the qualifications required?

4. Do you employ Instructional Materials for the school's Science programme?

Yes [] No []

5. What kinds of IMs do you use as a school?

6. How does the school get its IMs?

7. How often are these IMs acquired?

8. a. Does the school upgrade its stock of IMs? (a) Yes [] (b) No []

Specify any other answer.....

b. If Yes to Question 8, how does the school upgrade?

9. Averagely, how does the school invest in IMs for school's science programme?

.....

10. Specifically, what does the administration do to improve Science education in the primary department?

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APPENDIX C

OBSERVATION CHECKLIST FOR INDIGENOUS LEATHER FOR THE PRODUCTION OF INSTRUCTIONAL MATERIALS FOR NATURAL SCIENCE EDUCATION AT AHINSAN PRIMARY SCHOOL IN KUMASI METROPOLIS.

School's Name:

School's Location: pupils number:

..... Date:

Steps for Observing the Teaching of Science

1. Topic being taught.
2. Objectives of the topic.
3. Teaching strategy being used by the teacher.....
4. IMs employed for the lesson.
5. Kind of IMs being used.
i. Self - made ii. Purchased package iii. Locally made by visual experts
6. Materials used for the IMs.
7. IMs relate to the topic being taught. i) Yes [] ii) No []
8. Incorporation of the IMs into Science lesson by teacher.
9. Pupils' response to the IM.
10. IMs seem to promote understanding. i) Yes [] ii) No []
11. IMs engage pupils in the class.
12. IMs distract pupils during lesson. i) Yes [] ii) No []
13. Lesson was finished within allotted time. i) Yes [] ii) No []
14. Form of assessment given to students.

APPENDIX D

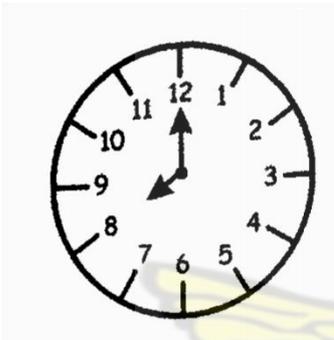
ANALYSIS TEST FOR INDIGENOUS LEATHER FOR THE PRODUCTION OF INSTRUCTIONAL MATERIALS FOR NATURAL SCIENCE EDUCATION AT AHINSAN PRIMARY SCHOOL IN KUMASI METROPOLIS.

(MEASUREMENT OF TIME)

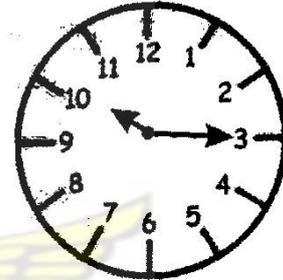
1. A digital watch or clock has no hands. **True/False**
2. A clock with hands is called. **Digital Clock/Analogue Clock**
3. The front of a clock is called the **Face/Back**
4. A clock with no hands is called but showing numbers is called? .

Digital Clock/Analogue Clock

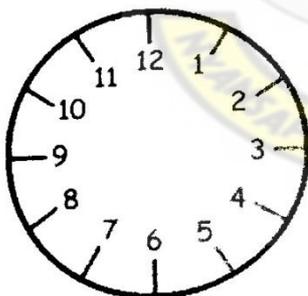
5. Write the time below the clock.



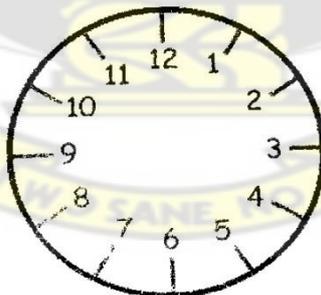




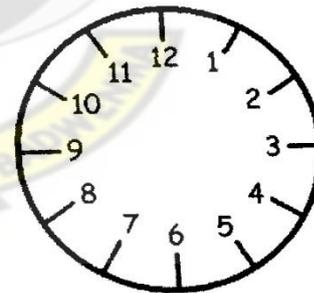
6. Draw the time in the clock



3:45



7:00



8:25

APPENDIX E

ANALYSIS TEST FOR INDIGENOUS LEATHER FOR THE PRODUCTION OF INSTRUCTIONAL MATERIALS FOR NATURAL SCIENCE EDUCATION AT AHINSAN PRIMARY SCHOOL IN KUMASI METROPOLIS.

(SENSE ORGANS)

1. helps us to taste food. **Tongue/Teeth.**
2. The largest sense organ is the **Skin/Nose**
3. Which organ is used to smell **Nose/Ear**
4. The organ for seeing is called **Skin/Eye**
5. Which organ is used for feeling items? **Nose/Skin**
6. Match the pictures of sense organs to their functions

Hear



Taste



See



Smell



Touch

