UNIVERSITY FOR DEVELOPMENT STUDIES, TAMALE

DEVELOPING A CIRCUIT-BOARD FROM LOCALLY AVAILABLE MATERIALS FOR SCIENCE EDUCATION IN PONG-TAMALE EXPERIMENTAL PRIMARY SCHOOL, SAVELUGU

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2017

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UDS/MTD/0085/15

THESIS SUBMITTED TO THE DEPARTMENT OF TRAINING AND DEVELOPMENT, FACULTY OF EDUCATION, UNIVERSITY FOR DEVELOPMENT STUDIES, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF EDUCATION DEGREE IN TRAINING AND DEVELOPMENT.

AUGUST, 2017

UNIVERSITY FOR DEVELOPMENT STUDIES

DECLARATION

Student's Declaration

I hereby declare that this thesis is the result of my own original work and that no part of it has been presented for another degree in this University or elsewhere

Student's Name: TIA ANTHONY KWAME

Signature: ……. Date: ……

Supervisor's Declaration

I hereby declare that the preparation and presentation of the thesis was supervised in accordance with the guidelines on supervision of dissertation laid down by the University for Development studies.

Supervisor's Name: Dr. Agatha Inkoom

Signature: …… Date: ……

ABSTRACT

As teaching and learning continue to evolve, TLMs form a significant part of lesson delivery most especially, at the basic school level. Again, as teachers continue to teach, their methods become absolute, and therefore, the need for continuous professional development of teachers to update their knowledge on the current issues of teaching and learning. This has necessitated the researcher to organise refresher training for upper primary teachers of Pong-Tamale Experimental Primary School on the use of locally available materials to develop a circuit board for the teaching of basic electronics. The researcher adopted qualitative action research design and made use of descriptive approach. Document review, interview and observation were the instruments used to gather and analyse data. Purposive and convenient sampling techniques were adopted. 8 respondents were sampled for this study which was made up of the head teacher for the selected school, the circuit supervisor and 6 teachers from the upper primary department of the selected school. The study identified materials from the immediate environment and developed them into an interactive circuit board for the teaching of basic electronics. The finished materials were tested in the upper primary to find out the effect of the improvised materials on teachers delivery and pupils performance. The study brought to light that teachers' delivery was systematic, class control was superb, the usual noise in the classroom was absent, pupils' participation was very good and pupils' interest were sustained throughout the lessons demonstrated by the teachers. Finally, pupils were able to answer both oral and written questions given them. Hence, the materials have made a remarkable impact in teaching and learning of integrated science.

ACKNOWLEDGMENT

My first thanks go to the Almighty God for giving me the strength throughout the entire process.

I acknowledge my supervisor, Dr. Agatha Inkoom, HoD for Basic Education Studies, University for Development Studies for supervising the entire work and for the encouragement I received from her. I say God richly bless you.

My gratitude also goes to my friend, Fuseini Abdul Somed for being an inspiration to me and willingly sharing knowledge and ideas with me throughout the work.

My warmest gratitude also goes to the head teacher of Pong-Tamale Experimental primary school for accepting me in the school to carry out my project work.

I sincerely thank my mother for her financial and moral support for me during the execution of the work

Finally, I thank all the lecturers of the Department of Training and Development, Faculty of Education, University for Development Studies for their selfless criticisms throughout the entire work.

DEDICATION

I dedicate this project to my Mother, Tia Sanatu, in memory of my late father, the entire family and all my friends.

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LIST OF ACRONYMS

BECE	-	Basic Education Certificate Examination
CBI	-	Cluster-Based In-service Training
CRDD	-	Curriculum Research and Development Division
DTST	-	District Teacher Support Team
DVD	-	Digital Video Disk
GES	-	Ghana Education Service
ICE	-	International Conference on Education
INSET	-	In-Service Education and Training
JHS	-	Junior High School
LCD	-	Liquid Crystal Display
LED	-	Light Emitting Diode
MoE	-	Ministry of Education
NGO's	-	Non-Governmental Organisations
PBL	-	Problem-Based Learning
PC	-	Personal Computer
PTA	-	Parent Teacher Association
SBI	-	School-Based In-Service Training
SHS	-	Senior High School

SMC	-	School Management Committee
TD	-	Training and Development
TLM's	-	Teaching and Learning Materials
TLRP	-	Teaching and Learning Research Programme
TV	-	Television

CHAPTER ONE

INTRODUCTION

1.0 Overview

Science in general at the primary and secondary levels of education is a vital component and at the heart of both economic growth and social development. There is an international consensus that a solid science education system in the school years is an indispensable requirement to having an economy based on knowledge and innovation (Gluckman, 2011). Science education, according to Curriculum Research and Development Division (CRDD), Ghana Education Service (2007), "will equip young people with the necessary process skills and attitudes that will provide a strong foundation for further study in science at the upper levels of education and beyond". In view of this, the researcher plans to update teachers' knowledge to use locally available materials to develop a circuit board to teach basic electronics in the upper primary at Pong-Tamale Experimental Primary School.

The chapter deals with the background to the study, the perceived problem, the purpose of the study, the objectives of the study, research questions, benefits of the study and delimitation of the study

1.1 Background of the Study

The use of locally available materials to support teaching and learning has being emphasised by many people across the globe, most especially in the sciences and yet some teachers still do not hold to this. In view of this, the researcher seeks to find out why some teachers are not ready to always improvise to support their lessons in Integrated Science. Education is a key for development of every nation of which science education forms one of the most vital subject area in the world. According to

Onasanya and Omosewo (2011:68), science is the foundation upon which the bulk of present day technological breakthrough is but nowadays, nations all over the world including Ghana are striving hard to develop technologically and scientifically since the world is turning scientific.

Mensah and Somuah, (2013) asserted that the growing trend of knowledge of science and technology is by no means a major contributing factor to the economic transformation of most of the world's economies. Science has changed the way the natural universe was viewed. When joined with engineering, modern technology and the global economic system; the methods and results of scientific inquiry are found to have profoundly affected humanity's material and societal progress. The fast advances in science and technology have influenced the rate of economic development of nations, improved the quality of life in most parts of the world, and provided solutions to some major problems and needs of societies. The impact of science and technology is felt on education, health, nutrition, transport and attitudes of science and technology (Anderson, 2006). In view of this, a country like Ghana needs scientific literate citizens who can make informed choices in their personal lives and approach challenges in the workplace in a systematic and logical order. They also need to become competent professionals in the various scientific disciplines who can carry out research and development at the highest level.

This implies that Science and technology has become the secret behind every developed country. In the world, countries with low development are those with high illiteracy rate. In all areas of life, progress and development of any country or community is centred on the effectiveness of Science and Technology. That is to say, no meaningful development or progress can be made without the knowledge of Science.

Science as an essential subject involves many concepts which are taught at all levels of our educational system, such as critical thinking, manipulation, ability to criticise and pass judgement, innovativeness and observation. Teachers who teach science would have to possess the necessary knowledge and skills in order to impact the right knowledge to students'. This can happen through refresher training of teachers to update their knowledge and this will enable pupils acquire basic concepts that will help them continue the study of the subject at higher levels. It is one of the subjects that can help learners to accomplish their goals and aspiration as far as the demands of the examinations is concerned.

In teaching Integrated Science, a lot of Teaching and Learning Materials (TLMs) are used in other to achieve maximum results. During the stay of the researcher in Pong-Tamale circuit as a teacher and one of the master trainers of the Savelugu-Nanton Municipality, the researcher realised that majority of teachers teach Integrated Science without the use of TLMs. The study will look at Circuit Supervisor perspective, head teacher perspective and teachers' perspective of the problem.

It is therefore, important to note that teaching and learning materials (TLMs) play a major role for students understanding of concepts and helps to reduce teachers work in the classroom. Teaching and learning materials form part of every successful lesson, most especially at the basic school level. Play has been identified as one of the key contexts for children early growth and development (French, 2007). When children interact with materials, learning becomes permanent. This will help to develop children knowledge, skills and attitudes that will prepare them adequately to face the realities of life when they become adults in future. It is therefore crucial to note that teaching and learning materials play a pivotal role so far as teaching and learning is concern. Young

children use teaching and learning materials as play materials which guide them to learn better.

According to Agudzeamegah (2014) as cited in Aina (2011) however, states that it will amount to wasteful exercise if a teacher decides to use materials that are not readily available or too costly to purchase, as a result, the idea of improvisation has to be employed to substitute for conventional instructional materials. According to Teaching and Learning Reseach Programme (TLRP) (2006), "unless school science explicitly engages with the enthusiasms and concerns of the many groupings that make up today's students, they will lose their interest". This implies that the science education is very important that every country of late rely heavily on the use of science and technology for high productivity in all fields. This is because; Science and Technology make research very easy since the people can now have access to the internet for information. To achieve this, teaching with TLMs is very necessary to realise the impact of science at the basic level and beyond. Hence, this has made the researcher to embark on this research.

1.2 Perceived Problem

Under the mission of Ghana Education Service, teaching and learning materials form one of the components for effective delivery of lessons in the classroom. In this regard, all teachers are obliged to prepare adequate teaching and learning materials to make lessons lively and interesting. This will enhance students understanding of concepts so that they will be able to apply the knowledge acquired in the real life situation.

However, some teachers at Pong-Tamale Experimental primary as well as the circuit in Savelugu- Nanton Municipality teach without these learning aids. This problem was identified by the researcher through observation as one of the master

trainers in the Municipality. The Circuit Supervisor, teachers and pupils were those the researcher interacted with. This problem may be one of the contributing factors for the poor performance of Science education in the Municipality and the nation as a whole. Reference is made to the poor performance of Science in BECE in the Municipality, especially 2012/2013 academic year. It is common to see a teacher teaching for a whole term without using even asingle teaching and learning aid and this inhibits student's productivity and academic achievement. In response to this problem, the study is to investigate into the problem that makes teachers fail to see the need to always improvise and use TLMs to deliver lessons.

Again, according to the researcher's observation, some science teachers in Pong-Tamale Experimental Primary as well as the Circuit do not use teaching and learning materials during teaching and learning process and this affects learners' performance in the Municipality. As a member of the District Teacher Support Team (DTST), the researcher also realised this challenge on his regular monitoring of schools on how teachers carry In-service Training on preparation and usage of teaching and learning materials, some schools are always not ready to prepare TLMs. This has necessitated the researcher to research on this topic.All the above have made the researcher to write on this topic to create awareness of the value of teaching and learning materials. (Chamuunorwa, 2010), teachers, especially those in primary education, should therefore be encouraged to use as many teaching and learning materials as possible to set an environment which is attractive and friendly for teaching and learning, and in which pupils can be easily guided through the discovery of knowledge on their own.

The researcher therefore with experience and knowledge gathered from the course of Masters in Education, Training and Development, into classroom instruction

and effective teaching and learning approaches sought to investigate the existing instructional materials used for science education and explore through detailed examination and systematic inquiry into locally available resources and develop teachers through training to become competent enough to be able to prepare materials to deliver effectively in the classroom. The researcher wills also pre-test the circuit-board through classroom observation. This will go a long way to prepare Integrated Science teachers in Pong-Tamale Experimental Primary and beyond to know the value of teaching and learning materials and that will translate much in pupils' performance in the school.

1.3 Problem Diagnosis

Play has been identified as one of the key contexts for children early growth and development (French, 2007). When children interact with materials, learning becomes permanent. This will help to develop children knowledge, skills and attitudes that will prepare them adequately to face the realities of life when they become adults in future. In the course of the researchers stay at the Municipality as a teacher, the researcher noticed that most teachers do not teach with teaching and materials. Children rather are engaged in rote learning. The researcher got to realise this unfortunate incident when he was appointed as one of the District Teacher Support Team (DTST). The major role of the team is to support teachers who have challenges in handling specific subject areas. Some teachers undermine the value of TLMs and therefore, do not even take into consideration the type of TLMs to be used when planning their lessons. It is as a result of the above mentioned incidence that has necessitated embarking on this research to contribute my quota to help teachers and pupils in the Municipality to be fully aware of the need to always use materials which are relevant to support teaching and learning in

the classroom.. This will help to build teachers professional growth and development and that can translate positively in students' performance.

- **Evidence:**

I. In-formal observation: Observation showed that some Integrated Science teachers in the school teach without TLMs which is worrying.

II. Interview: A few of the pupils are willing to pursue science after the Basic Education Certificate Examination and also few teachers make effort to improvise materials to support teaching and learning.

III. Quizzes and class exercises reveal that only less than half of the pupils get the average mark in Integrated Science at the upper primary.

IV. Results of Entrance exams for primary six pupils who are transiting to the Junior High School in 2016 brought to light that less than half of students score the average mark in Integrated Science.

- **Causes of the Problem**

Observation

- inadequate skills of some teachers to prepare self-made TLMs
- Insufficient resource allotment to the teaching and learning of Science at the basic schools.
- Teachers who are not trained as science teachers assume to be teaching the subject.
- Some teachers do not always prepare adequately before going to the classroom.

Interview:

- Teaching and learning materials are expensive to acquire.
- Most people perceive science to be a very difficult subject or course to pursue. Hence, the teaching of science is affected.
- Lack of interest by people to take up science courses from the Primary to the university level.
- Developing the capacity of science teachers to make them competent is very low.
- Inability of some teachers to improvise materials to support teaching and learning. Rather they complained that they have no finance.

According to Mensah and Somuah, (2013), the fast advances in science and technology have influenced the rate of economic development of nations, improved the quality of life in most parts of the world, and provided solutions to some major problems and needs of societies. The impact of science and technology is felt on education, health, nutrition, transport and communication. Our continued existence depends on the mastery of the knowledge and attitudes of science and technology (Anderson, 2006).In view of this, a country like Ghana needs scientific literate citizens who can make informed choices in their personal lives and approach challenges in the workplace in a systematic and logical order. They also need to become competent professionals in the various scientific disciplines who can carry out research and development at the highest level. Therefore, the general aims for science education at the basic level are meant to help pupils to:

a. Develop understanding of scientific concepts and principles;

b. Develop an appreciation for the application of science to life;

c. Think and act scientifically; and

d. Develop scientific attitudes towards life.

In order to realise the above goals, Ghana has sought to increase and sustain interests in science and technology and in science related programmes at the basic, secondary and tertiary levels of education. Aina (2011) has the view that primary education is the bedrock of educational continuum and it requires a solid foundation in science. According to Maduabum, (1991), Science must be made real to pupils in primary schools through appropriate teaching methods, use of good instructional materials and improvisation where it is indispensable. According to Olumorin (2009), as cited in Olumorin, Yusssif and Ajidagba (2010) mentioned that in the absence of original materials for use in teaching and learning, other types and forms of instructional materials can be applied. Abimbola (1999) also explained that the prime purpose of using supportive materials in the teaching and learning process is to make teaching more effective and facilitate learning. Therefore, science education at the basic level should be real and practical. This will help equip them and prepare them adequately to continue with science at the highest level. Once the interest is built, most students will be willing to take up science courses which will subsequently bring growth and development the nation, Ghana.

The researcher made a visit to the school to find out how teachers deliver lessons in integrated science, the observation of the researcher showed points such as:

- Inadequate instructional materials for teaching science at the basic level.
- School head confirmed decline in the performance of students in Science over the past years especially with reference to BECE results due to the lack of interest of pupils in the Science subject, a problem which may start from the lower primary level of education.

- Some teachers stated that the imported instructional materials are based on foreign concepts which make it difficult for some children to relate to ideas in the classroom.
- Some pupils also confirmed that hardly do they see their teachers using TLMs in the classroom. All they do is use the chalk-and- board method.

The preliminary investigations also brought to light how handicapped most of the instructional materials are. The researcher therefore aims at equipping teachers at Pong-Tamale Experimental primary and the Circuit through training them on TLMs preparation and usage, most especially improvisation through the use of locally available materials to support science lessons and to create awareness of the significance of science education.

1.4 Statement of the problem

Teaching and learning materials form one of the components for teaching and learning process. However, some teachers still teach without these teaching aids. The researcher has organised and monitored a series of INSET programmes for teachers in the Circuit including Pong-Tamale Experimental Primary where the researcher works but one major challenge of teachers in the school is teaching Integrated Science with the requisite TLMs. This practice has affected pupils' performance over the years. This has prompted the researcher to research into the problem by organising refresher training for the upper primary teachers on how to build a circuit board using locally available materials for science education in the school.

1.5The purpose of the study

To help teachers develop a circuit board from locally available materials for teaching integrated science through refresher training at Pong-Tamale Experimental Primary School.

1.6 Objectives of the Study

1. To use locally available materials and develop them into a circuit board for teaching and learning of integrated science at Pong-Tamale Experimental Primary School.

2. To train teachers on how to develop the circuit board to teach integrated science at Pong-Tamale Experimental primary school.

3. To pre-test the developed circuit board on the teaching and learning of integrated science at Pong-Tamale Experimental Primary School.

1.7 Research Questions

The following research questions guided the study:

1. What are the locally available materials that can be used to develop a circuit board for teaching and learning of integrated science at Pong-Tamale Experimental Primary School?

2. What kind of training do teachers need to equip them to be able to improvise TLMs for science education in Pong-Tamale Experimental Primary School?

3. What will be the impact of the designed circuit board on teaching and learning of integrated science at Pong-Tamale Experimental Primary School?

1.8 Significance of the Study

Science teachers in Pong-Tamale Experimental primary school and other stakeholders in education will be exposed to the significance of using teaching and learning materials. Hence, the results may serve the following purpose:

- **Parents.** The results of this study will serve as bird's eye view of the parent to know the needs of their children with regards to the use of TLMs and make conscious efforts to support their children at home when assignments are given to them by teachers.
- **Teachers.** This study may heighten their awareness of the value of improvising TLMs in lesson delivery so that pupils will be able to follow instructions better. It will put teachers in a good condition to adopt the use of self-made materials to facilitate teaching and learning. Hence, they will be able to improvise. It may help equip the teachers to handle Integrated Science effectively and efficiently through refresher training on the use of teaching and learning materials in the circuit.
- **Pupils.** Having a clearer view of the significance of TLMs, this will further enhance pupil's understanding of concepts and ideas. Therefore, performance of pupils at the basic level will be improved.
- **District.** With the use of the results of the study, the directorate will be fully aware of the essence of using TLMs and to monitor teachers effectively. Monitoring and supervision will be enhanced through the use of the results of this finding. This will put teachers on their toes to deliver lessons up to expectation.
- **Future Researchers.** The information that will be gained from this study mayserve as guide for other researchers in framing their

conceptual framework and design and they can modify it to bring change in the society. Hence, it may serve as a reference material for future researchers.

- **Curriculum Planners.** The findings of this study may assist the planners in the proper selection of methods, techniques, and strategies of using TLMs to enforce its use in teaching and learning process.

1.9 Delimitation

This study was limited to the development of a circuit board from locally available materials for teaching and learning Integrated Science at Pong-Tamale Experimental Upper Primary School through refresher training in the Savelugu-Nanton Municipality, Northern Region of Ghana.

CHAPTER TWO

LITERATURE REVIEW

2.0 Chapter overview

The researcher intends developing a circuit-board from locally available materials for science education in Pong-Tamale Experimental Primary School, Savelugu. The aspect under investigation is that, Upper Primary Science teachers in the school are to undergo refresher training to adequately equip them to handle basic electronics in the school. Hence, the need to organise refresher training for teachers to be able to improvise locally available materials to form a circuit board for teaching basic electronics in Pong-Tamale Experimental Primary School.

The conceptual analysis takes a critical look at Basic education in Ghana, Science education, teaching, methods of teaching, learning, training, refresher training, concept of teaching and learning materials, types of teaching and learning materials, improvisation, merits and demerits of teaching and learning materials. This study is backed by the theory of learning and intellectual development of children by Piaget. Adaptation explained by Piaget is the ability of a child to interact with his environment. Therefore, the researcher considers this theory as a means of helping to develop an attractive circuit board from locally available materials for science education at the upper primary of Pong-Tamale Experimental Primary School.

2.1 Conceptual analysis

2.1.0 Concept of Science Education

According to United Nations Education, Scientific and Cultural Organisation (2010) Scientific development in recent decades has, and will continue to have a significant influence on topics that have great importance for humanity, quality of life, the

sustainable development of the planet, and peaceful coexistence amongst peoples. From the immediate basic essentials of life such as access to water, food and shelter, to important issues that affect us all (management of agricultural production, water resources, health, energy resources, biodiversity, conservation, the environment, transport, communication), all have a strong science component to which everybody should have access to take part in local, regional, national and transnational decisions in a meaningful way. We also live in a world where poverty and riches live side by side. The gap between them is increasing. Science must not only respond to the needs of society in order to improve the quality of life of the majority population which lives in poverty; it should also be used by all citizens, men and women. To be usable, scientific advances have to be known and owned.

The impact of universal primary education and adult literacy on poverty reduction has not been actually felt in most countries in Sub-Sahara Africa, (at least in Ghana). No doubt, universal and general education has a crucial role to play in the developments of nations; however, such education must have a focus. Perhaps in the effort at improving access to education, more emphasis should be placed on science education. Although there are science-based courses at the primary, junior high and senior high schools in most Sub- Saharan Africa, not much have been documented on the prospects of science-education in poverty reduction. More importantly, the extent to which the teaching and learning of sciences in primary and Junior High schools can help bring about reduction in the level of poverty of the students, their parents, member of their immediate environment and ultimately the society at large has not been fully studied because some teachers still fail to incorporate TLMs during lesson delevry in Sciece. It is on the basis of this that research focuses on what promises teaching and learning activities in the science classroom at the primary and junior high school level

can offer in the effort of reducing poverty in developing countries (Adegoke, 2015).Hence, science education should be taught at the basic school level with a lot of teaching and learning materials in order to lay a solid foundation for the pupils.

Aina and Keith (2015) have the view that Science education is not clearly defined in primary school in Ghana, except for the study of basic science and technology. In the secondary schools, there is basic science at the JHS level. At the Senior High School (SHS) level, there is Biology, Chemistry and Physics taught separately. Science education is clearly defined to be biology, Chemistry, and Physics studied together with the principle and method of education. The principle that guides the study of Science in Ghana is similar to that of other African countries. That is the Integrated Science consists of Chemistry, Physics, Biology and Agriculture.

Many teachers handling the science subjects in most of our secondary schools specialises in science, not in science education (Omosewo, 2009). Hence, these teachers lacked appropriate instructional strategies for teaching and often used lecture method. This is situation a teacher is assigned to teach subjects for which he or she has not got adequate training and qualification as a science teacher (Ingersoll, 2002). These categories of teachers' need fresher training on teaching method as most of them teach using the lecture- based during instruction time. The lecture method has been criticised by many for lack of effective interactive approach and caused poor academic performance in science education.

The performance of students in science subjects in the resent times has not been very good (Erinosho, 2013). Among the causes of this poor performance is the teachers' method of teaching (Wanbugu, 2013). Due to the above augments on this, it is

important to take a look at the different types of teaching methods use by science teachers in science education, their disadvantages and the need for a shift of paradigm.

2.1.1 Basic Education in Ghana

Agudzeamegah (2014) remarked that Education in Ghana is centrally administered under the purview of the Ministry of Education (MoE), which is responsible for the formulation of educational objectives at the national level. This ministry oversees the Ghana Education Service (GES), which is responsible for pre-tertiary levels of education which covers KG, Primary, JHS, SHS.

The goal of Ministry of Education is to provide relevant education to all Ghanaians at all levels to enable them to acquire skills that will assist them to develop their potentials to be productive; promotion of technology culture at all levels of society, to facilitate poverty reduction and to promote socio-economic growth and national development (Ministry of Education, 2012. Page 3). Under the implementation of the 2010-2020 Sector Strategic Plan (ESP 2010-2020), the basic education sub sector is positioned to provide equitable access to good-quality, child-friendly universal basic education, by improving opportunities for all children in the first cycle of education at Kindergarten, Primary and Junior High School levels.

The number of children accessing basic education in Ghana continues to rise with the 2014/15 statistics showing marked improvements over that of 2013/14. Gender parity, an indication of equitable access to school for both boys and girls has been achieved and sustained at the KG and Primary levels. At the Junior High School level, GPI increased from 0.95 to 0.96. In addition, completion rates have almost reached 100% at Primary school, and have increased substantially to 73.5% at JHS. Transition rate from P6 to JHS1 has also reached 99.1% (Ministry of Education, 2014).

According to (The Basic Education Division, Ghana Education Service, 2004), the teacher has always been central to every education reform process around the world and therefore teacher education should be of major concern to national policies that have development goals of poverty reduction and wealth creation.

The provision of quality education involves adequate preparation of quality and dedicated teachers who should provide the knowledge and skills required by the human resources of a nation.

In this regard, teachers play a key role in nation building especially in human resource capacity building, especially on TLMs preparation and usage.

Consequently, the Government of Ghana regards teachers, teacher unions and other organisations of the teaching profession as partners whose efforts would improve quality teaching, social cohesion, democratic values and culture of peace in schools and communities. In Ghana, the major challenge confronting education as regards the provision of quality education for all is being pursued at all levels. For instance, basic education is undergoing drastic reforms to include pre-primary education as part of the basic compulsory education system.

In this regard, all children especially those in deprived and difficult areas are being given equal access to good quality education. The school curriculum has been improved to address the issues of cultural diversity, social cohesion and principles of democratic values among pupils and students. Since the Government of Ghana recognises the capacity of teachers to bring about peace and harmony into societies and communities, it has taken concrete steps to implement the Declaration and Recommendations of the 45th Session of the International Conference on Education (ICE), 2002 in its national policies. Hence, capacity building of teachers should remain paramount in our basic education school system, most especially on the use of teaching

and learning materials during lesson delivery. This will make teachers effective and they will be in position to deliver lessons for children to be able to grasp concepts better.

2.1.2 Teaching

UW-Stout 3.06 (2010) explained that teaching follows the following ways: instruction, evaluation, student-academic advisement, academic program planning, and curriculum development. Instruction is the imparting of knowledge, developing of skills and attitudes, and meeting of special needs in various ways ranging from structured to individualised activities, including instructional support activities which aid and enrich the teaching-learning process. Evaluation is vital to the instruction process and is a basis for academic program planning and student advising. Academic advising is the sharing of information between faculty and student regarding the student's academic progress or professional goals, and assists the student in maximizing the benefits from the educational experience.

Academic program planning identifies educational goals and contributes to their implementation. Curriculum development may be directed towards either course or program development and may involve credit or non-credit activities.

IGI Global (2017) explained teaching in the following ways: The activities involved in facilitating or educating to impart knowledge or skills to learners. Hence, to teach means to do the work of teaching practically. In education, teaching is the concerted sharing of knowledge and experience, which is usually organised within a discipline and, more generally, the provision of stimulus to the psychological and intellectual growth of a person by another person or a group of persons. Pre-planned behaviours informed by learning principles and child development theory which directs and guides instruction to ensure desired students outcomes.

Teaching is an instruction or delivering a particular skill or subject or something that someone tells you to do. For Teaching in this case may refer to showing or explaining to a student how to do something. Teaching is considered as deliberate actions undertaken with the intention of facilitating learning. Teaching is an activity aimed at bringing about meaningful learning through a method that is morally and pedagogically acceptable. It involves a teacher, a learner, content in form of knowledge facts information and skill to be imparted a deliberate intention on the part of the learners to learn, and finally a method that respects the learner's cognitive integrity and freedom of choice.

IGI Global (2017), therefore, has the view that, there are two fundamentally different ways of understanding teaching. The first sees teaching as an instructor-centred activity in which knowledge is transmitted from someone who has acquired that knowledge to novice learners: teaching as knowledge transmission. The second sees teaching as a learner-centred activity in which the instructor ensures that learning is made possible for novice learners and supports, guides, and encourages them in their active and independent creation of new knowledge, to impart knowledge or skill; give instruction, inform, enlighten, discipline, drill, school, indoctrinate; coach to help to learn. It involves the interaction of three elements: the teacher, student and the object of knowledge.

2.1.3 Methods of Teaching

Kizlik (2013) explained that teaching methods are mainly descriptions of the learning objective-oriented activities and flow of information between teachers and students. The choice of teaching method to be used depends largely on the information or skill that is being used to teach, and it may also be influenced by the aptitude and preparedness of learners. It is vital that all teachers within all environments are aware

of the merits and demerits of all methodologies currently being used in the classrooms. This awareness will then enable every teacher to structure learning to meet the needs of all persons (learners) while satisfying the requirements of the curriculum as prescribed for all schools.

Teaching methods include discussion, lecturing, demonstrations, practical, experiments, note-giving, role playing, questioning, brainstorming, group work and seminars.

- Discussion: This is a method which can be used with the entire class or in small groups to review information, illuminate ideas or solve problems. It is conducted as a period of oral comments, questions and answers led by the teacher in which class members actively participate (Huze, 2011). Discussion has been described by (Brookfield, 1995) as both inclusionary and participatory because everyone has some useful contribution to make to the educational effort and because it claims to be successful with actively involving learners.
- Lecturing: In this method, teaching is usually characterised by one way communication; information or ideas are normally passed on to students orally while they listen. Adu (2008) has a view that lecturing is the most frequently used method of instruction that has dominated formal education over the years. Bligh (2002) asserts that the purpose of the lecture is to clarify information to a large group in a short period of time. Ideas or concepts are presented by the teacher while students listen and take down notes.
- Demonstrations: In demonstrations, an activity is performed so that learners can observe how it is done in order to help prepare learners to transfer theory to practical application; the teacher shows a skill while students watch. To carry

out a demonstration effectively, the intended activity must be carefully planned, kept simple and thorough enough to meet the objectives of the lesson. Demonstrations may be augmented with other visuals and learners are given the opportunity to practice what they have watched. This teaching method helps visual learners, enhances self-confidence, provides opportunity for targeted questions and answers and allows attention to be focused on specific details rather than general concepts (Teacher and Educational Development (2012:3)

- Brainstorming: Brainstorming is a process for generating multiple ideas or options in which judgment is suspended until a maximum number of ideas have been generated. Options are then typically analysed, a best solution identified and a plan of action developed. Students are usually asked to throw out as many ideas as possible in a short time either in groups or whole class, while someone often writes the ideas down. Brainstorming actively involves learners in higher levels of thinking, promotes peer learning, critical thinking and creates synergy. It also helps groups reach consensus. But brainstorming requires that learners discipline their inputs to the discussion.
- Role Play: According to (Kizlik, 2013), it introduces problem under study dramatically and provides opportunity for students to assume roles of others and thus value another point of view allowing for discovery of solutions and providing occasion to practice skills. It also develops problem-solving and verbal expression skills providing practice to build skills for real-world relevance and when actual experiences are not readily available. Role playing provides teacher with prompt feedback about the learner's understanding and capacity to apply theories and ideas.

- Project-based: Project-based learning is the use of in-depth and rigorous classroom projects to facilitate learning and assess student competences. It is an instructional method that provides students with complex tasks based on challenging questions or problems that involve the students' problem solving, decision making, investigative skills, and reflection that includes teacher facilitation. It is also focused on questions that drive students to encounter the central concepts and principles of a subject in a hands-on method. It allows students to develop valuable research skills as students engage in design, problem solving, decision making and investigative activities (Buck Institute for Education, 2013).

The variety of teaching methods imply that a teacher has options to choose from but essentially, the selected methods of instruction should build on a foundation of pupils' previous knowledge, ensuring that the choice of teaching method encourages children to learn by doing, ensures learning develops from useful experience and experimentation, effective use of instructional aids, and creates a conducive learning environment in the classroom. The choice of teaching method must also stimulate appreciation as well as cognitive growth and help varying groups of pupils to get the most proficient learning out of all lessons (Agudzeamegah, 2014),

2.1.4 Learning

Learning is equal to memorising and the ability to reproduce what is memorised, usually in a school test setting. Reproduction is the product, while the process is memorising (Erik, 2010). Learning is seen in quantitative terms: learning more is being able to reproduce more.

The Institude of Education, University of London, (2002), define learning as:

> ……..activity which enables the learner to draw upon previous experience to understand and evaluate the present, so as to shape future action and formulate new knowledge.

This implies that learning is the ability to recall or perform an activity that has been studied and that has a positive impact on the learner. For learning to become permanent, one needs to teach with a variety of teaching and learning materials. Most students learn through the interaction with materials which are attractive or appealing to the eye. Below is model of how learning takes place according to (Dennison, 1990)

Figure 1: 1 A model of the learning process. Adopted from Dennison and Kirk (1990)

The cycle above shows activity in learning (Do), the need for reflection and evaluation (Review), the extraction of meaning from the review (Learn), and the planned use of learning in future action (Apply). The model may describe the process for a learner on her/his own who is actively making sense of a learning situation, or for a group of learners involved together. Whatever the overall time scale, time is required for individuals to reflect, make meaning, and move forward (Dennison, 1990). This

implies that for learning to be noticed, the learner should be able to apply what has been learnt.

- **Types of Learning**

Michael (2004) identified four type of learning. These include: Active learning, collaborative learning, cooperative learning and problem-based learning.

- **Active Learning**

Active learning according to Michael (2004)is generally defined as any instructional method that engages students in the learning process. In summary, active learning requires students to do meaningful learning activities and think about what they are doing. This includes activities such as homework, project work and in practice active learning refers to activities that are introduced into the classroom. The core elements of active learning are student activity and engagement in the learning process. Active learning is often contrasted to the traditional lecture where students passively receive information from the teacher.

- **Collaborative Learning**

This type of learning refers to any instructional method in which students work together in small groups toward a common goal**.** As such, collaborative learning can be viewed as encompassing all group-based instructional methods, including cooperative learning

In contrast, some authors distinguish between collaborative and cooperative learning as having distinct historical developments and different philosophical roots. In either interpretation, the core element of collaborative learning is the emphasis on student interactions rather than on learning as a solitary activity (Michael, 2004),

- **Cooperative Learning**

Cooperative learning can be defined as a structured form of group work where students pursue common goals while being assessed individually. The most common model of cooperative learning found in the engineering literature is that of Johnson and Smith (2003). This model incorporates five specific tenets, which are individual accountability, mutual interdependence, face-to-face interaction, appropriate practice of interpersonal skills, and regular self-assessment of team functioning. While different cooperative learning models exist, the core element held in common is a focus on cooperative incentives rather than competition to promote learning.

- **Problem-Based Learning (PBL)**

This is an instructional method where relevant problems are introduced at the beginning of the instruction cycle and used to provide the context and motivation for the learning that follows. It is always active and usually (but not necessarily) collaborative or cooperative using the above definitions. PBL typically involves significant amounts of self-directed learning on the part of the students. It could be a project work a group of students or individual students.

All the above types of learning can be integrated to bring effective learning.

2.1.5 The concept of teaching and learning materials

They are the materials a teacher uses in her/his lessons to bring about the understanding of ideas and concepts. According to Adjei, Ansah and Baffoe (2015), teaching and learning resource is a generic term used to describe the resources teachers use to deliver instructions. Broadly, teaching learning resources refers to a spectrum of educational materials that teachers use in the classroom to support specific learning objectives as

set out in the lesson plans. It implies that teaching and learning materials support and make lessons interesting and understanding of concepts in a faster and easier way. Learning materials can be sophisticated which may be expensive and others too can be found within the local setting. In this regard, teachers should be versatile enough to improvise so that lessons will be captivating.

Klaus (2010) explained that teaching learning materials are tools that classroom teachers use to help their students learn quickly and thoroughly. A teaching aid can be as simple as a chalkboard or as complex as a computer program, because every individual learns in a different way, teachers rely on these tools to explain concepts to students with a wide variety of learning needs. This attest to the fact that, every individual is created differently with different learning needs. Some people learn through seeing (visual learners), some through hearing (auditory learners), and others through manipulation (motor kinaesthetic learners) and finally, others combine the three to learn (motor sensory learners). The above categories of learners must be taken care of during lessons delivery. This will ensure that all pupils move at the same pace. Hence, this creates room for effective and efficient teaching and learning. T LMs are used to convey information in the classroom. Tamakloe, Amedahe and Atta (2005) also defined teaching learning materials as a material which the teacher uses to facilitate the learning, understanding and acquisition of knowledge, concept, principles or skills by his students. In short, teaching learning materials in education are the use of equipment and materials that are relevant to motivate, inform, instruct and present the subject matter to the learner as well as making learning easier than it would have been without using it.

Most people think that, teaching learning resources refer to only materials which the teacher prepares and uses in the classroom to facilitate learning.(Mialaret, 1966), as

cited by Adjei, Baffoe, Ansah and Baffoe (2015), also said that teaching learning resources help the teacher but does not replace him in teaching and learning processes. This also implies that teaching learning resources will complement the efforts of the teacher to bring understanding to the students or pupils during teaching and learning process.

- **Types of teaching and learning materials**

  - Visual teaching and learning materials
  - Audio teaching and learning materials
  - Audio/Visual teaching and learning materials/TV and Video

- **Visual Teaching and Learning Materials**

Visual teaching and learning materials are the materials that can be seen with the eye. According to Adjei Baffoe etal (2015), a visual aid is any object or picture that relates to the subject being taught. It is something you bring to support whatever project or report you are discussing. It gives the listener something concrete to look at to enable a better understanding of what you are teaching. Nacino-Brown, Festus and Desmond (1982), disclose that, visual resources could be objects and specimen hence providing direct first-hand experiences which are necessary for concepts formation. Students can see, touch, smell and even taste them giving a richer and more meaning to them.

From all the explanations above, it can be deduced that teaching and learning materials add value to lesson delivery. Hence, they make lessons interesting and enhance children understanding. Examples of visual aids are; calendars, actual objects, cardboard illustrations, blackboard illustrations, wall charts, models, slide shows, pictures and many more.

- **Audio Teaching Learning Materials**

Audio teaching learning materials/ audio aids are materials that involve the use the sense of hearing. They are things that one can listen to or hear (sound) that can support teaching and learning. According to Adjei etal (2015), Audio resources are the aids that involve the sense of hearing. They are resources to help the student hear and speak. Audio aids are the aids that influence the learner's auditory sense (sense related to listening and hearing). The following are examples of audio teaching and learning materials; tape recorder, record player, radio, and so on. These materials help children to learn on their pace since the sound can be played later by pupils after the teacher teaches, especially slow learners in the classroom.

- **Audio-Visual Teaching Learning Materials**

According to Tamakloe et al. (2005) audio visual aids or resources are aids that cater for both audio and visual perceptions. When the teacher uses an exclusively audio aid and supplements it with the use of visual aids or resources, the teacher is appealing to both audio and visual perceptions. This is how audio visual resources were initially combined and hence the hyphenated form of "audio-visual". Examples include slight projectors, TV, film-strips or a transparency with the running of commentaries or the use of explanations and descriptions simultaneously by the teacher.

Research has shown that the proliferation of the media and technology worldwide, has contributed greatly to why educators are now moving away from the use of print media or the manual way of teaching in their classrooms, to the use of video.

The above mentioned phenomena has changed the way educators teach and how the learners learn and has therefore made it necessary for educators to upgrade their skills in the use of educational videos in their classrooms.

According to Berk (2009), using videos in teaching is not new. They date back to prehistoric times when cave instructors used 16mm projectors to show cave students examples of insurance company marketing commercials in business courses. Now even DVD players are history. So what's new? There are changes in four areas: (a) the variety of video formats, (b) the ease with which the technology can facilitate their application in the classroom, (c) the number of video techniques an instructor can use, and (d) the research on multimedia learning that provides the theoretical and empirical support for their use as an effective teaching tool. A PC or Mac and LCD projector with speakers can easily embed video clips for a PowerPoint presentation on virtually any topic.

He added that when you watch a movie or TV program, superficial and even deep feelings and emotions are elicited, such as excitement, anger, laughter, relaxation, love, whimsy, or even boredom. These emotions are often triggered or heightened by the mood created by specific visual scenes, the actors, and/or the background music. A video can have a strong effect on your mind and senses. It is so powerful that you may download it off the Internet or order the DVD from Amazon along with the CD soundtrack so you can relive the entire experience over and over again. This attraction to videos extends to movies, TV programs, commercials, and music videos. So how can faculty in all courses use video clips as an instructional tool so their students can experience the powerful cognitive and emotional impact they can provide? Quite possibly those students eventually may want DVDs of their classes.

- **Merits of teaching and learning materials**

Teaching and learning materials has played and will continue to play a major role in teaching and learning process. The value of these materials cannot be measured so far as teaching and learning is concern. Below are the merits of teaching and learning materials:

- Teaching and learning materials Foster creativity students
- They increase the flow of ideas
- Foster deeper learning and critical learning
- Provide an opportunity for freedom of expression in the classroom
- They Serve as a tool for collaboration
- Capture students' attention
- Allow students' to concentrate
- Generate interest in the classroom
- Provide a sense of anticipation
- Make students strong for learning exercise
- Increase students' imagination
- Improve attitudes toward learning in the classroom
- Build a connection with other students and instructor
- Increase memory of content area of the learning process
- Increase understanding concepts, ideas and knowledge
- Decrease anxiety and tension on scary topics
- Create memorable visual images
- Inspire and motivate students to learn
- Make learning fun

- Finally, they Set an appropriate mood or tone in the classroom.

- **Demerits of teaching and learning materials**

Though teaching learning materials play a pivotal role in teaching and learning process, there are some disadvantages attached to the use of these resources which teachers must be aware of to be able to manage their classes very well. Below are the demerits of TLMs:

- Some TLMs are expensive to purchase. Hence, quality materials take time to produce (improvise) which can affect the teachers' time to deliver lessons.
- Some teachers are very poor with the creation of materials. Hence, the concept to be delivered may be altered if the right material is not used.
- If care is not taken, some of the TLMs can affect the students negatively. This is because some of the materials are very difficult to handle.
- Some of the teaching aids do not meet the demands of all categories of students in the classroom. For example; students with special needs.
- Materials which are downloaded from the internet can be affected by virus that can affect already existing documents in the computer.
- In the case of audio visual aids, some students can use the material negatively. That is by using the net to watch pornographic films.
- Some students too can use them as games and make them lose the value and the actual work they are meant for.

2.1.6 Improvisation (the use of locally available materials)

Improvisation is defined by Okoro (2004), as the sensor experience given to learners as an alternative to ideal objects , topics, ideas and events aimed at effective teaching and learning. Okala (2005) also sees improvisation as a make-shift, quickly in time of

need, using whatever happens to be available to achieve teaching goals. Though it may not adequately replaces the well-researched and developed equipment, tools and consumables but it keeps the system going while the most appropriate materials are sought for. Involving the learner in encountering knowledge through hearing, seeing, discussing and manipulating concrete materials, learning is enhanced(Okoro, 2004) The use of concrete materials during instructional time also help learners to discover concepts and ideas by themselves that can have a mental picture in their minds, improve their critical thinking and build their confidence level. This can have a lasting effect on them as they grow to become adults.

According to Aginobu (2005), many learners find it difficult in understanding certain concepts they consider abstract and that teachers' repeated efforts to explain such concepts without using a replica or a real object ill meet with little success and this replica sometimes is improvised.

This implies that improvisation is the use of locally available materials to support teaching and learning. These materials can stand in place of the sophisticated materials which are most at times very expensive to come by. Improvise materials are relatively cheap to come by and sometimes can be gotten free from the environment. Effective teaching and learning require the use of several teaching aids of which most of them should be improvised. Looking at the cost implication of improvising local instructional materials, (Momoh, 2005), presented improvisation as the construction of cheap and simple alternatives by the teacher to facilitate teaching and learning. Improvising teaching aids was practiced and advocated by Pedro and Orata, as stated in (Bishop, 2001:6). This team of missionaries in early Central Africa region displayed their ingenuity in this statement. "If we had waited until all was well provided, building, textbooks, science equipment, well qualified teachers and so, a good number

of children and young people who are now enrolled in High schools and colleges would still be waiting for a chance to go to school." This means that material that were thrown away were gathered and used as teaching aids. In effect, all teachers should be versatile enough to make good use of locally available materials to support teaching and learning in the classroom. This is the only way we can do as teachers to support the few sophisticated materials supplied by the government and the non-governmental organisations in our schools. Hence, performances can be improved in the examination at all levels in education.

Improvisation is a crucial aspect so far as teaching and learning is concern. Teachers need to cultivate the habit of always trying as much as possible to gather materials which are cheap and are found in the immediate environment to support lessons delivery. When teachers adopt this strategy, performance of children will be improved and at all levels in education in Ghana. It is so surprising to realise that most teachers teach even the lower classes without the use of learning materials. That is at the nursery and kindergarten levels. At this stage, children need concrete materials to be able to learn effectively. For example, cut out papers, pebbles, sticks, empty tins of different shape, size, colour and height. These materials can greatly support children to learn.

The researcher agrees to Piaget theory of intellectual development to some extent. The stages of cognitive development is key for every teacher to note during teaching and learning process but the researcher's view is that some children at the Pre-operational stage can learn concepts in the concrete operational stage provided the children are equipped with the appropriate teaching and learning materials and conducive learning environment provided.

Again, the four types of learning identified by Michael (2004) are in line with the stages of Piaget theory of intellectual development of the child. That is active learning, collaborative learning, cooperative learning and problem-based learning. Children have to be taken through these stages systematically according to their ages. This will help to equip the child with the right knowledge at every stage in life. Therefore, concepts which are above the level of children should not be taught to children. Hence, teachers should consider the ages of children before planning lessons for children.

The researcher also agrees with Kolb (2008) model (theory) which propounded four stages of learning experience as concrete experience, observation and reflection, abstract conceptualization and active experimentation. This implies that in a learning situation, the learner should be taken through a series of activities (experiment) with the help of concrete materials, observe critically what is being demonstrated, perform the activity with little guidance and finally, being able to recall what has been learnt and apply it in one's daily life (Kolb, 2008).

2.2 Aspect under investigation

The researcher aims at developing teachers' capacity to use locally available materials to build a circuit board for teaching basic electronics (simple electrical circuit) at Pong-Tamale Experimental primary school.

2.2.1 Refresher training

Training refers to a planned effort by a company or institution to facilitate employees' learning of job- related competencies. These competencies include knowledge, skills, or behaviours that are critical for successful job performance. The goal of training is for employees to master the knowledge, skill, and behaviours emphasised in training programs and to apply them to their day-to-day activities (Noe, 2010).

Nischithaa (2014) asserts that; training is concerned with imparting specific skills for a particular purpose. Training is the sequence of learning a sequence of programmed behaviour. Training is the act of increasing the skills of an employee for doing a particular job. “Training is the process that provides employees with the knowledge and the skills required to operate within the systems and standards set by management.” (Sommerville, 2007). Nischithaa (2014) again explained that; training is a learning process that involves the acquisition of knowledge, sharpening of skills, concepts, rules, or changing of attitudes and behaviours to promote the performance of employees. Training is a continuous process by which employee actually gets the knowledge and get to know how he or she can perform well in the organization or institution.

According toBodanapu (2013),‘It is quite obvious that skills fade with time. There may be various reasons for this degradation of skills. Most often it is because of lack of regular usage of skills and choosing of alternative methods by the employees. Whatsoever the reasons may be, the needs for refresher training have to be identified and addressed, to ensure that the skills are updated and remain current’. The purpose of the refresher training courses is to review, reinforce and upgrade workers or teachers ' existing knowledge and skills. There are different reasons for the need for refresher training, e.g. refresher training for students whose training has been discontinuous, teachers whose teaching methods become absolute and the need to introduce new concept in carrying out the work effectively.

2.2.2 Significance of Refresher Training

Below is the importance of refresher training according to (Bodanapu, 2013)

- To retain the existing talent.
- To keep pace with the new technologies.
- To become the beneficiaries of the current innovations.
- To get the best out of your people.
- To update with the latest trends.

Frequent refresher training would be a good idea, but most often refresher training can be called for even before the stipulated time when the need arises. Generally, it is delivered in cycles. Normally this period is decided based upon the kind of job, the skills and the critical safety factors required to do the job. But how can you identify when your existing employees are in need of refresher training?

Here are some signs that help you get to know the need to deliver refresher training to your employees. (Bodanapu, 2013):

- Repeatedly failing to complete the assigned tasks on/in time.
- Poor response to training given.
- Less output.
- Unwilling and indifferent attitudes.
- Frequent accidents and safety factors.
- Finding it difficult to take-up/accept new concepts.

Hence, this has made the researcher to organise refresher training for teachers to equip them with the skills of improvisation to handle integrated science topics.

2.3Theoretical framework

This study is backed by the theory of learning and intellectual development of children by Piaget. Adaptation explained by Piaget is the ability of a child to interact with his environment. Therefore, the researcher considers this theory as a means of helping to develop an attractive circuit board from locally available materials for science education at the upper primary of Pong-Tamale Experimental Primary School. The following quotation supports the assertion that the learning environment should always be made conducive and attractive for learning (Simatwa, 2010).

> Piaget's theory asserts that intellectual development is a direct continuation of inborn biological development. That is the child is born biologically equipped to make a variety of motor responses, which provide them with the framework for the thought processes that follow. That is, the ability to think springs from the physiological base. Piaget maintains that intelligence is rooted in two biological attributes found in all living creature: organization and adaptation. Organisation is the tendency of every living organism to integrate processes into coherent systems. It occurs, for instance, when an infant, originally capable of either looking at objects or grasping them, integrates these two separate processes into a higher order structures which enable him to grasp something at the same time he looks at it. Adaptation is the innate tendency of a child to interact with his environment. This interaction fosters the development of a progressively complex mental organization. Each stage in this sequence of development provides the foundation for the next stage permitting progressively complex and effective adaptations to the environment. Adaptation comprises two complementary processes of assimilation and accommodation. The child assimilates experiences and fits them into the expanding structure of the intellect when he encounters new experiences which he cannot fit into the existing structure accommodation, or modified way of reacting takes place. Piaget stresses that as children mature mentally, they pass sequentially through four major stages of cognitive development, each stage having several sub stages. The major stages of cognitive growth are:
>
> 1. Sensory motor stage - 0 - 2 years
>
> 2. Preoperational or intuitive stage - 2 - 7 years
>
> 3. Concrete operations stage - 7 - 11 years
>
> 4. Formal operations sage - 11 - 15 years
>
> These stages are of a probabilistic nature. At most ages it is possible for a child to exhibit behaviour characteristic of more than a single stage because heredity interacts with environment. Each stage is a system of thinking that is quantitatively different from the preceding stage. Each stage is a major

> transformation in thought processes compared to the preceding stage. The stages are sequential and follow an invariant sequence. This means that the child cannot skip or miss a stage or by - pass a stage. He must go through each stage in a regular sequence. Children cannot overcome a developmental lag or speed up their movement from one stage to the next. They need to have sufficient experience in each stage and sufficient time to internalize that experience before they can move on.

Hence, a child needs to go through these stages before she/he becomes fully equipped with the knowledge needed for later life. This is done through the use of appropriate teaching and learning materials at each stage of the child's development.

(Bruner, 1966), explained that Instruction consists of leading the learner through a series of activities of a problem or body of knowledge that increase the learner's ability to assimilate , transform, and transfer what he is learning. In short, the sequence in which a learner encounters materials within a domain of knowledge affects the difficulty he will have in achieving mastery

> If it is true that the usual course of intellectual development moves from enactive through iconic to symbolic representation of the world, it is likely that an optimum sequence will progress in the same direction

Instruction is a situation that helps the learner to be a problem-solver self-sufficient. Therefore, the teacher must correct the learner in a nice way that will make it possible for the learner to take over the corrective function himself. This can be achieved through the use of teaching and learning materials that are appealing to the child.

The use of locally available materials to support teaching and learning is one of the most important areas that should be encouraged by all teachers most especially in teaching integrated science as a subject in the national curriculum.

> Island (2008), Learning Resource will refer to any person(s) or any material (whether acquired or locally produced) with instructional content or function that is used for formal or informal teaching/learning purposes. Learning resources may include, but are not limited to, print and non-print materials;

audio, visual, electronic, and digital hardware/software resources; and human resources.

Morohunfola (1983), as cited by,Aina (2013), instructional materials help teachers to meet individual differences of learners in the classroom by using materials that are appealing to different senses. The materials take care of visual learners, auditory learners, motor kinaesthetic learners and multi-sensory learners. Those materials are used to supplement verbal explanation of concepts or ideas so that the lesson could be real to the students. These instructional materials are categorised into audio visual, audio and visual. Audio visual materials can appeal to student both sight and hearing. These can be electronically operated materials like Television, Radio, Film, Slide motion; Computer and non-electronic ones such as Chalk board, Charts, Burners, Models and many more. The absence of these materials in teaching of integrated science could make the class very boring to students and discourage learning which can result to low or poor performance.

The researcher strongly agrees that teachers should consider students with different learning styles. This will help teachers to use locally available materials to prepare instructional materials that will cater for every individual student in the classroom. The theory will help the researcher to select content and materials for every age level or the class of the pupils. Bruner's theory will also guide the researcher to analyse the materials to be used to carry out the training for teachers and pupils at the upper primary school. The themes in the literature review are discussed below:

This research is also guided by experiential learning theory. This theory was propounded by Kolb (2008). Kolb proposed a four-stage learning process with a model that is often referred to in describing experiential learning.

This process can start at any of the stages and is continuous; there is no limit to the number of cycles you can make in a learning situation. In participation in science activity, learners begin from a step and then continue to the end of the activity. This theory has the view that without reflection we may continue to repeat our mistakes in the learning process. The theory found that learners learn using teaching and learning materials in steps with the likelihood of developing one mode of learning more than another. Kolb (2008), as cited by Stephen (2013), the characteristics of this theory are through concrete experience, through observation and reflection, through abstract conceptualisation and through active experimentation. For example, for every learner to experience that light travels in a straight line, the learners must observe this through passing light in three or more holes with the help of a light source using teaching and learning materials like cupboard and a candle. Learners interact with materials before learning will take place.

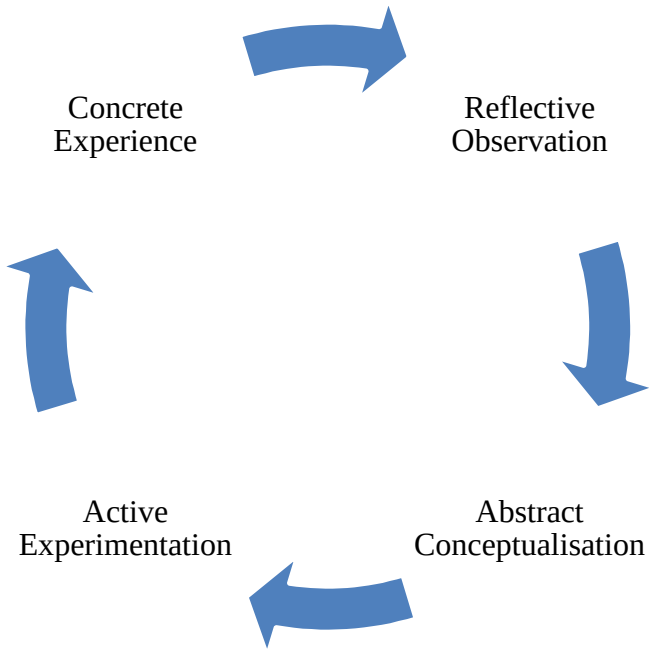

Figure 1.2 Experiential Learning Style Model

Source: (Kolb 2008), experiential learning style model

The model above indicates that at the active experimentation stage, learners go through a series of activities to find solution for a problem, the concrete stage tells us that the learning must be put into practice, the reflective stage shows that the outcomes are analyse objectively and finally, the abstract conceptualisation stage is to review conceptual understanding. This theory guides the researcher to develop materials found in the local environment for Science Education.

2.3.1 Point of Departure

Piaget theory of intellectual development proposes four stages of intellectual development of children. According to the theory, learners must pass through the stages sequentially without skipping a stage. In contrast, the researcher is of the view that children can skip one of the stages and still perform well provided adequate and conducive environment is provided. The researcher is to bridge that gap in Piaget's theory by proving that children can actually learn concepts better in any stage when the environment and the teaching aids are well prepared and demonstrated well to children. Hence, the research intends to close that gap.

Again, in Kolbs model, it indicates that at the active experimentation stage, learners go through a series of activities to find solution for a problem, the concrete stage tells us that the learning must be put into practice, the reflective stage shows that the outcomes are analysed objectively and finally, the abstract conceptualisation stage is to review conceptual understanding. He emphasised that the learning can start at any of the stages but the researcher disagrees with that in a sense that in a learning situation, learners should always be taken through experiment with a lot of teaching and learning materials. This done through demonstrations by the instructor or the teacher before children practice the concept. For example, learners cannot start reflecting on the

learning outcomes when they have not been taken through the learning process. The researcher is of the view that in going through the model, learning should not start at any level of the model but it should be sequential. That is experimental stage, concrete stage, reflective stage and conceptualisation stage. Therefore, the researcher intends to bridge that gap for learners to be able to grasp concepts or ideas better.

Dennison proposes a learning cycle as activity in learning (Do), the need for reflection and evaluation (Review), the extraction of meaning from the review (Learn), and the planned use of learning in future action (Apply). According to him, the model may describe the process for a learner on his/her own who is actively making sense of a learning situation, or for a group of learners involved together. Whatever the overall time scale, time is required for individuals to reflect, make meaning, and move forward. This implies that for learning to be noticed, the learner should be able to apply what has been learnt. The circle does not indicate the instructor's role in the learning process because learners cannot be left alone to carry out activities. They need guidance and support to be able to perform. The researcher therefore, intends to involve teachers and pupils in the development and usage of a circuit board to be able to handle basic electronics especially simple electrical circuit. When they are involved in the learning process, they will also be in a better position to help others when the need arises.

2.3.2 Conclusion to Literature Review

The literature review looked at the following key areas: Theoretical review, Basic education in Ghana, Science education, teaching, methods of teaching, learning, training, refresher training, concept of teaching and learning materials, types of teaching and learning materials, improvisation, merits and demerits of teaching and learning materials.

Adegoke view on science education is that it should be taught at the basic school level with a lot of teaching and learning materials in order to lay a solid foundation for the pupils. This is in line with the theory backing this research which states that learners' ages should be considered when planning lessons and the right teaching and learning materials should be selected in order to achieve good results.

The researcher also agrees with Aina who said instructional materials help teachers to meet individual differences of learners in the classroom by using materials that are appealing to different senses. Hence, his ideas are in line with the researcher's view on the use of locally available materials to enhance the teaching of basic electronics in the upper primary. Therefore his idea is in line with the theory backing this research.

From Kolb's theory, there four stages learners should go through. That is through concrete experience, through observation and reflection, through abstract conceptualization and through active experimentation. According to his theory, learners can start with any of the stages with the researcher does not agree to that because his idea deviates a bit from the theory backing the researchers idea. Learning should be systematic and age of the learner is paramount during teaching and learning according to the theory backing this research but Kolb's idea is that learning can start at any stage of his stages of experiential learning.

Erik's idea on learning is that learning is said to have taken place when the learner is able to memorise and reproduce what has been learnt. Hence, the researcher agrees with his idea because when concept or idea is taught to children, the instructor expects the learner to perform well during test. This is in line with the theory backing this research because Brunner's idea of Instruction consists of leading the learner

through a series of activities of a problem or body of knowledge that increase the learner's ability to assimilate , transform, and transfer what he is learning. Hence, the researcher strongly agrees with Erik's idea.

In conclusion, the researcher's work is to enhance learners understanding through the use of locally available materials for science education at the upper primary school.

CHAPTER THREE

METHODOLOGY

3.0 Chapter overview

This research is aimed at making teachers competent through in-service training on the use of locally available materials for science education in the upper primary of Pong-Tamale Experimental primary School. It deals with the design of the materials and also observing teachers teach with the materials after the training is done. Results of the intervention and post- intervention will be juxtaposed to see the changes.

The research process was also designed to serve as a catalyst for increasing acceptability of the use of improvised materials in classroom practice by teachers. Section 3.1 of this chapter presents the profile of the study area, section 3.2 discussed in detailed the research design used in the methodology. Section 3.3 and 3.4 present the population of the study area and sample and sampling techniques respectively. In Section 3.5, data type and source are discussed, 3.6 highlights data collection instruments for the study, section 3.7 talked about procedure that is used for data collection, 3.7.1 discussed pre-intervention procedures in detail. Section 3.7.2 discussed the intervention strategies. This is where the actual work (intervention) is presented. Section 3.7.3 of this chapter talked about Post-intervention process. This where the researcher determines the outcome of the intervention put in place. Data is analysed and presented in section 3.8. Section 3.9 of this chapter presents the quality, trustworthiness and alignment criteria and how these are addressed in this study. Conclusion of the chapter is finally presented.

3.1 Profile of study area

Pong-Tamale Experimental primary is located athe Bolgatanga highway in the Savelugu Municipality in the Northern Region of Ghana. Majority of the inhabitants are farmers. Others are traders while a few are salary workers, either with the government or private organisations. Pong-Tamale is a heterogeneous society with the natives being Dagombas by tribe and they are the predominant. Other tribes include Akan, Gonja, Hausa, Fulani, Bimoba and Kusaasi. Most of these people are involved in several vocations including farming and trading.Pong-Tamale Experimental Primary School was established in 1979. It is situated in the central veterinary laboratory premises. Before its establishment, Pong-Tamale M/A Primary School was the only School in the community. The reason of its establishment was that workers in the departments in the community used to send their wards to Schools in Kamina, Mile 9 and Tamale. With this, they found it necessary to establish a School near them where they can be monitoring, supervising and evaluating teaching and learning progress in the School. They needed quality education for their wards. Children who were enrolled in this School were only Children of the officers, workers from the community and a few prominent people in the community. The initiative was a collective decision taken by all the officers in the various departments in the veterinary college.

The then director of central laboratory, Dr.I.K.Akalaku was the leader of this initiative. The premise was given out by the central veterinary laboratory. This was formerly used as a poultry house, horse stable, rabbit production, sheep pen, long-tennis court and some parts as canteen. The School started with a nursery and primary. Two head teachers were managing the School. The P.T.A/S.M.C realised the need for a Junior high School and hence in 1993, Pong-Tamale Experimental Junior High School was established. Due to the effective management and academic performance of the

school over the years, the school was selected as one of the model schools in the municipality. The school has a total population of 690 pupils of which 350 are females and 340are males. Apart from Kindergarten 1 and 2 which are one stream each, the rest of the classes (basic one to six) are two streams each. The school currently has staff strength of seventeen. Seven are females and ten are males.

3.2 Research design

The qualitative action research design was adopted by the researcher for this study. Qualitative research is the approach usually associated with the social constructivist paradigm which explains the socially constructed nature of reality. It is about recording, analysing and attempting to uncover the deeper meaning and significance of human behaviour and experience, including contradictory beliefs, behaviours and emotions. It is aimed at gaining a rich and complex understanding of people's experience (Alzheimer Europe, 2009). Qualitative research is concerned with the systematic collection, ordering, description and interpretation of textual data generated from talk, observation or documentation. Qualitative research methods include the techniques of interviewing, observation, and document analysis. Its goal is to explore the behaviour, processes of interaction, and the meanings, values and experiences of purposefully sampled individuals and groups in their "natural" context (Simon, Janice and Carol, 2008: 243-246). Quantitative research also seeks a deeper truth of a problem which enables researchers to study things in their natural setting attempting to make sense or interpret phenomena in terms of the meanings people bring to them and therefore, uses the holistic perspective to preserve the complexities of human behaviour (Greenhalgh, 1997).

Qualitative research is concerned with developing explanations of social phenomena. That is to say, it aims to help us to understand the world in which we live and why things are the way they are (Hancock, 1998). He added that qualitative researchis concerned with the social aspects of our world and seeks to answer questions about:

- Why people behave the way they do
- How opinions and attitudes are formed
- How people are affected by the events that go on around them
- How and why cultures have developed in the way they have
- The differences between social groups

Qualitative research is concerned with finding the answers to questions which begin with: why? How? In what way?

Advantages of qualitative research, according to Hancock (2002), are that it describes social phenomena as they occur in their natural setting. This implies that qualitative research gives a distinct and rich approach to understanding what, how and why events occur in their natural settings. He added that Qualitative research is concerned with the opinions, experiences and feelings of individuals producing subjective data. Understanding of a situation is gained through a holistic perspective. Quantitative research depends on the ability to identify a set of variables. Data are used to develop concepts and theories that help us to understand the social world. Qualitative data are collected through direct encounters with individuals, through one to one interviews or group interviews or by observation.

However, some weaknesses associated with qualitative research are that data collected is time consuming because it takes place through direct encounter with participants such as interviews or observations. Large samples cannot be worked with due to the

intensive and time consuming nature of how data is collected; hence small group is preferred to be able to work within the stipulated time.

The researcher uses the action research method to enable him use locally available materials to train upper primary teachers on designing a circuit board to teach basic electronics at the upper primary in Pong-Tamale Experimental Primary School. Action research is a process of systematic inquiry that seeks to improve social issues affecting the lives of everyday people (Stringer, 2008). According to Mills (2011) as cited by Hine (2013:152), action research is an attractive option for teacher researchers, school administrative staff, and other stakeholders in the teaching and learning environment to consider.

- **Reasons for Adopting the Qualitative Research Design**

The researcher adopted the qualitative research design because the study does not involve in statistical procedure for investigation, hence the qualitative research design helped the researcher to study deep into the problem. It was appropriate to adopt the qualitative research design since it enables one to find out the availability and the usage of locally available materials for teaching basic electronics in Pong-Tamale Experimental Primary School. The qualitative design was also selected to study how teaching and learning materials are made up of, how the materials would help both teachers and pupils during teaching and learning of Integrated Science in the selected school. It was also adopted since the problem was based on its natural setting that is Pong-Tamale Experimental Primary School in the classroom situation. Qualitative data gathered were studied and analysed to produce a meaningful picture of how teaching and learning materials are used in the selected primary school for teaching Integrated

Science most especially at the upper primary school in pong-Tamale Experimental primary school.

3.3 Population of the study

A population is a group of elements or cases, whether individuals, objects, or events, that conforms to specific criteria and to which a researcher intends to generalise the results of the research (Asamoah-Gyimah, 2007). This means that the group the research have interest to work with and which the results can be generalised.

The population for the study was thecircuit supervisor, the head teacher and six upper primary teachers. Hence, the population for this study was eight (8).

3.4.1 Sampling Technique

Sampling technique adopted for this study had an effect on how the results can be generalised. In this study the purposive and convenience sampling techniques were employed for the study.

> The purposive sampling technique, also called judgment sampling, is the deliberate choice of a participant due to the qualities the participant possesses. It is a non-random technique that does not need underlying theories or a set number of participants. Simply put, the researcher decides what needs to be known and sets out to find people who can and are willing to provide the information by virtue of knowledge or experience It is typically used in qualitative research to identify and select the information-rich cases for the most proper utilization of available resources (Etikan, 2016).

Purposive technique was adopted to select the head teacher, teachers and classes for the study because this category of people had knowledge on teaching and learning materials.

According to Etikan (2016), Convenience sampling (also known as Haphazard Sampling or Accidental Sampling) is a type of non-probability or non-random sampling where members of the target population that meet certain practical criteria, such as easy

accessibility, geographical proximity, availability at a given time, or the willingness to participate are included for the purpose of the study. Therefore, the researcher used convenience sampling techniqueto select the primary school for the study since it was close to the researcher. This saved the researcher time from travelling long distance for data collection and analysis.

Hence, the sample size for this study was 8 respondentswhich represent 100% of the accessible population.

3.5 Data type and source

The typesof data that were collected for the study were primary and secondary data.

> Primary data are fresh (new) information collected for the first time by a researcher himself for a particular purpose. It is a unique, first-hand and qualitative information not published before. It is collected systematically from its place or source of origin by the researcher himself or his appointed agents. It is obtained initially as a result of research efforts taken by a researcher (and his team) with some objective in mind. It helps to solve certain problems concerned with any domain of choice or sphere of interest. Once it is used up for any required purpose, its original character is lost, and it turns into secondary data (Akrani, 2014)

Hence, primary data collected by the researcher included field notes and pictures from observing classroom teaching and learning of Science and interviews with headteacher and upper primary teachers at Pong-Tamale Experimental Primary School.

According to Akrani (2014) again explained that Secondary data are information already collected by others or somebody else and later used by a researcher (or investigator) to answer their questions in hand. This data is usually obtained mostly from different published sources like companies' reports, statistics published by government, etc. Here, the required information is extracted from already known works of others (e.g. Published by a subject scholar or an organization, government agency, etc).

Therefore, Secondary data was gathered by the researcher from books, online documents, journals, published and unpublished thesis, school records and other documents that are related directly to Integrated Science and the use of teaching and learning materials at the primary school level in Ghana.

3.6 Data collection instruments – action research tools

The researcher adopted interview and observation as instruments for data collection for the research work.

3.6.1 Interview as a tool for data collection

An Interview is a conversation carried out with the definite aim of obtaining certain information and again, interview is design to gather valid and reliable information through the responses of the interviewee to a planned sequence of questions (Asamoah, 2007). This means that an interview is a mutual interaction between an interviewer and interviewee to find out about information regarding a situation.

According to Rita (1999:1), interview is a type of interaction which researchers use to elicit information in order to achieve a holistic understanding of the interviewee's point of view. It can also be used to explore interesting areas for further investigation. This type of data collection process involves asking informants open-ended questions, and probing wherever necessary to obtain data deemed useful by the researcher for a study most especially for qualitative data collection. Interview can be structured, semi-structured and unstructured.

The researcher employed unstructured interview to find out the state, usage and benefits of using improvised teaching and learning materials, the nature of refresher training they have undergone at Pong-Tamale Experimental primary school. The circuit supervisor was also interviewed on how teachers use those materials during monitoring and supervision and how often the district organises refresher trainings for teachers on

TLMspreparation and usage. Dialogue wasadaptedto interview participants to ensure that they were comfortable to express themselves and willing to share information on the subject matter very well.

3.6.2 Observation as a tool for data collection

Observation is a careful study and recording results of events such as activities, behaviours, actions and other aspects of human behaviour for the benefit of fulfilment of a task or study.

> Observation is way of gathering data by watching behaviour, events, or noting physical characteristics in their natural setting. Observations can be overt (everyone knows they are being observed) or covert (no one knows they are being observed and the observer is concealed). The benefit of covert observation is that people are more likely to behave naturally if they do not know they are being observed. However, you will typically need to conduct overt observations because of ethical problems related to concealing your observation (Education Evaluation Team, 2008).

Education Evaluation Team (2008:2) again added that, Observations may also be either direct or indirect. Direct observation is when you watch events such as interactions, processes, or behaviours of people as they occur in their natural setting; for example, observing a teacher teaching a lesson from a written curriculum to determine whether they are delivering it with fidelity. Indirect observations are when you watch the results of interactions, processes, or behaviours without participant's awareness that they are being observed. But because of ethical issues, this method may not be acceptable. Hence, the researcher employed the direct observation as a tool for data collection.

- **Justification for using observation as a tool for data collection**

Observation was used to get much information on how Integrated Science is being taught at the Upper Primary school in Pong-Tamale Experimental Primary School, the kind of materials used during lesson delivery, pupil's reactions towards integrated

science lessons, and availability of TLMs and how they are made or produced and finally, the methods used by teachers to deliver integrated science lessons.

3.7 Data collection procedure

The procedures employed by the researcher in this study were direct observationand unstructured interview.

3.7.1 Situational analysis (pre-intervention)

Situational analysis is a way of identifying and analysing the state of a problem and how to solve the problem or make changes that can improve upon an existing problem. A situational analysis is a systematic collection and evaluation of past and present economic, political, social, and technological data, aimed at identifying internal and external forces that may influence the classroom or organization's performance and choice of strategies and assessment of the classroom or organization's current and future strengths, weaknesses, opportunities, and threats (Business Dictionary, 2017).In view of this, the researcher conducted a needs assessment to find out the state of the identified problem in detail.

Permission was asked from the head teacher in the selected school through writing to carry out a situational analysis of the problem, which was the use of locally available materials in teaching and learning process in integrated science in the upper primary of Pong-Tamale Experimental primary school.

- **Main findings during the situational analysis using the research tools**

1. **Interviews**

The researcher carried out three sets of unstructured interview. The first one was with the head teacher. The researcher asked about his qualification, years of experience in

the teaching field, his age, number of years as a head and number of in-service training he has organised and attended for 2016/2017 academic year. The interaction with the head teacher revealed that some teachers in the school teach without using TLMs, others state the TLMs in their lesson notes but they don't use them during teaching and learning process and others lack the skills in preparing their own materials to support the few sophisticated materials available. He added that the school has organised a number of in-service training but TLMs preparation and usage was not part of the training. The second interview was with six teachers. Four of the teachers remarked that preparing TLMs is tedious and therefore, they use TLMs drawn in the pupil's texts books. One teacher said that he prepares TLMs sometimes to deliver lessons and the sixth teacher also remarked that TLMs are costly to purchase and therefore, they resorts to the few sophisticated TLMs available to deliver lessons. The final interview was scheduled with the circuit supervisor. The researcher arranged with him to choose a convenient date which took place at the Municipal education office three days after the interview with the teachers and head of the school. According to the circuit supervisor, most teachers lack the skills of improvisation. He said this is realised during his usual monitoring and supervision. He also stated that it is common to see a teacher teaching for a whole term without preparing and using self-made TLMs to deliver lessons. The researcher asked how often the directorate organises training for teachers and areas where they organise these training on. He responded that the directorate has organised training in Early childhood (early grade reading), numeracy for lower and upper primary, literacy for lower primary and leadership for head teachers. Integrated science especially TLMs preparation and usage was not stated by the circuit supervisor.

2. Observation

Observation of lessons was also made in all the classes of the upper primary in the selected school. It was revealed that some teachers failed to use the active learning approach (child centred method) of teaching to deliver lessons which is usually done with enough TLMs; rather they still use the lecture method to deliver lessons. According toBell and Kahrhoff(2006:3), active Learning is a method of teaching whereby students are actively engaged in building understanding of facts, ideas and skills through completion of teacher directed tasks and activities. It is also any type of activity that gets all students involved in the teaching and learning process. Hence, the active learning approachis paramount when it comes to learning process but it was a different picture during the lesson observation. This made some of the pupils sleeping and some were making noise and doing different things all together during learning process. It was realised that teachers still use the traditional seating arrangement in the class that is on rolls in the primary level which does not help during learning process.

3. Document Review

Document review is a process of examining existing documents to ascertain facts about a situation. These records are reviewed to find out the state of the existing problem.

> Document review is a way of collecting data by reviewing existing documents. Documents may be hard copy or electronic and may include reports, program logs, performance ratings, funding proposals, meeting minutes, newsletters, and marketing materials (Education Briefs, 2009).

The researcher reviewed teacher's lesson notes to see how teachers incorporate teaching and learning materials into their lessons. It was realised that some teachers do indicate TLMs but they don't use them during learning process and some do not even show how to use the materials in the activities column of the lesson plan. Hence, the researcher planned to organise a short training session for the selected teachers to

update their knowledge on how to use locally available materials to prepare TLMs for science education in the school in the intervention. Materials prepared will be used to demonstrate at the Upper Primary level in the school.

Another document that was reviewed is in-service training file to determine the frequency of how in-service training is organised in the school, especially on TLMs preparation and usage in integrated science. It was revealed by the head teacher that the school has organised a number of in-service training but that did not include the preparation of TLMs and usage. Hence, the need to organise this training session to help bridge that gap in the selected school.The researcher also reviewed documents on the existing TLMs in the school. It was revealed that the school depends greatly on the few TLMs provided by Ghana Education Service which are woefully inadequate for the school considering the population of the school. TLMs provided were mainly charts and play equipment. According to the teachers, they depend largely on the pictures in the pupil's text books as TLMs to deliver lessons. Pupils exercise books also confirmed that the number of exercises given were woefully inadequate. However, class five teacher used flowers from the environment to teach parts of the flower. All pupils participated well since they all had flowers at their desks to interact with.

Hence, the document review helped the researcher to adequately formulate the interview guide for the respondents. The observation made also guided the researcher to structure the interview guide which helped to bring to light that some teachers actually teach in abstract which is worrying. Hence the need to combine the three research tools to help solve the challenge through refresher training.

- **Challenges experienced during the situational analysis**

Some teachers failed to appear during the interview session and gave reasons that they were not prepared for that day. A different date was set for them and this affected the researcher's time for completing the interview on time. The circuit supervisor's date for the interview was also rescheduled because he was to attend to another important function at the directorate.

During the lesson observation, some teachers repeated old lessons which did reflect the actual performance of teachers and pupils during lessons. Classroom management was also a challenge since most of the lessons taught were abstract. Pupils were not engaged or put at the centre of learning process and they made noise which affected the teachers' delivery.

The document review session also had some challenges. Two teachers out of the six teachers failed to provide their lesson notes books because they were not up to date. Some thought that the results of the findings could be sent to the Municipal directorate even upon assuring them about the confidentiality of the findings and therefore they refused to present their lesson note books. Hence, the above challenges slowed down the time stipulated for the data collection process during the situational analysis.

3.7.2 Intervention

The intervention was to train teachers on how to develop a circuit board using locally available materials for teaching (building simple electrical circuits) for science education in Pong-Tamale Experimental School. Under the mission of Ministry of Education and Ghana Education service, the use of locally available materials found in the environment can be used to support teaching and learning in the primary schools. In view of this, the researcher identified a gap with regards to the use of these materials

for teaching science since most teachers rely heavily on chalk board illustrations, pictures in the pupil's text books and the few charts which were supplied by Ghana Education Service. This prompted the researcher to come out with strategies that can help teachers to be able to deliver lessons properly by taking them through how to design an interactive circuit board for them to be able to handle the subject very well.

An in-service training was organised for the head teacher and six selected teachers at the upper primary department in the school. According toHandicap International (2014:1), in-service training is a kind of trainingorganised for teachers who are already working as teachers or qualified as teachers.In-service training can be organised for a group of teachers from different schools, or can be organised for a whole team of teachers in one school (whole-school approach).The significance of in-service training is that, teachers can almost immediately put into practice what they have learned in the training and participants have a lot of experiences that the trainer can build on to help them teach with effectively. The training took two days period and time for it was agreed by the head teacher and the teachers. It was decided that the training is organised outside contact hours. The agreed date was 10th May to 11th May, 2017. That was Wednesday and Thursday. Below is a time table that guided the conduction of the in-service training:

Table 1.1Building simple electronic circuit for teaching Integrated Science- Training Programme

Day 1			**Day 2**		
TIME	**ACTIVITY**	**WHO**	**TIME**	**ACTIVITY**	**WHO**
2:00-2:10 PM	Registration	All	2:00-2:05 PM	Opening prayer	Participant
	Opening Prayer	Participant	2:05-2:20 PM	Recap	All

2:10-2:25 PM	Key note address and introduction of facilitator	Head teacher	2:20-2:30PM	Materials needed for construction of an electrical circuit	All
2:25-2:30 PM	Self-introduction	All	2:30-3:30 PM	Use of locally available materials to construct a simple electrical circuit	Tia Anthony Kwame
2:30-2:40 PM	Objectives of the training programme	Tia Anthony Kwame		Use of locally available materials to construct a simple electrical circuit	All
2:40-3:00 PM	The concept of TLMs Improvisation	Tia Anthony Kwame		Use of locally available materials to construct a simple electrical circuit	All
3:00-3:10 PM	**SHORT BREAK**		3:30-3:40 PM	**SHORT BREAK**	
3:10-3:30 PM	Examples of locally available materials that can be used for making TLMs	Tia Anthony Kwame		Use of locally available materials to construct a simple electrical circuit	All
3:30-4:30 PM	Group work and presentation on 'collecting locally available materials and suggesting topics for them'	All Two groups		Use of locally available materials to construct a simple electrical circuit	All
4:30-4:45 PM	Summary of the day's activities	Tia Anthony Kwame	3:40-4:00 PM	Workshop evaluation	All
4:45-4:50 PM	Closing prayer and departure	All	4:00-4:10 PM	A thank you note the facilitator, Closing prayer and departure	

3.7.3 Post-intervention

After the intervention, a demonstration lesson was organised in basic six to see the impact of the designed circuit board. The enrolment of the class was 45 and the teacher

arranged pupils in a “horse shoe” formation. This was done to ensure that all pupils could see the processes involved in developing the interactive circuit board .The teacher introduced the lesson by reviewing pupil’s relevant previous knowledge on energy and linked their responses on the topic ‘building simple electrical circuit’. All pupils were very quiet upon seeing the circuit board. The teacher who received the training demonstrated how to assemble the material to form a circuit board. Pupils were put into five groups. The teacher made them to choose group leaders and each group interacted with the circuit board. At the end of the lesson, pupils were able to mention the components of circuit board (simple electrical circuit) and were also able to put the components together to produce light.

3.8 Data analysis and presentation

Data was analysed and presented through the use of the objectives of the study and the action research tools –observation and interview.

3.8.1 Activities undertaken for objective one

Objective one was to use locally available materials and develop them into a circuit board for teaching and learning of integrated science at Pong-Tamale Experimental primary school. Materials gathered for the production of the interactive circuit board were: plywood, hammer, saw, nails, empty packing case, dry cells, connecting wire, switch, bulb (LED), adhesive (“99” glue), plastic beads and pencil.

- **Processes involved in developing the circuit board**

The plywood was measured using a meter rule and cut in a square with the help of the saw. The pencil was used to demarcate the areas where all the components were to be fixed. An empty case was measured and cut for making a case for the two battery case. The nails were used to fix stands at the edges of the board with the help of the hammer.

The adhesive was used to hold the battery case on the board. The other components were used to mount on the board with the help of the adhesive. The plastic beads were fixed at ends of the connecting wires to serve as insulators. The material was tried and tested to see how it works.

3.8.2 Activities undertaken for objective two

Objective two was to train teachers on how to develop a circuit board to teach integrated science at Pong-Tamale Experimental primary school. Date and time for the training was agreed by the head teacher and the six teachers. That was 10th May to 11th May, 2017. That was Wednesday and Thursday after school. They selected the days and time because they did not want to go contrary to the term scheme of work and the contact hours. Activities for the first day were: registration, opening prayer, training norms, expectations, key note address and introduction of the facilitator by the head of the school, self-introduction, objectives of the training, Improvisation/concept of teaching and learning materials, Examples of locally available materials that can be used for making TLMs, Group work and presentation on 'collecting locally available materials and suggesting topics for them', Summary of the day's activities and Closing prayer and departure.

Activities for the second day were: Opening prayer, recap of day one activities, Materials needed for construction of an electrical circuit, Use of the locally available materials listed to construct a simple electrical circuit, Workshop evaluation, a thank you note by the facilitator, Closing prayer and departure.

- **Observations made during the refresher training**

All participants reported to the training venue on time and that was impressive and a signal that the teachers were dedicated and time conscious. After the opening prayer,

self-introduction, norms and expectation, the head teacher introduced the researcher as the facilitator for the 2-day refresher training. The researcher took participants through the objectives of the training session which were:

- To state what TLMs and improvisation are.
- To mention locally available materials that can be used to teach integrated science at the upper primary level.
- To list and used locally available materials that can be used to build a circuit board for teaching basic electronics at the upper primary level.

Participants were put in a semi-circle seating arrangement which allowed each participant to see clearly what was demonstrated. The first day was used to achieve activity one and two while objective three was catered for by the second day due to the time consuming nature of building the circuit board. Participants were put into two groups. Group one answered question two and group two answered question one. After the group work, participants did presentation of their work. All participants made inputs to both presentations and that was refreshing to everybody.

Day two was used to construct a circuit board using locally available materials for teaching integrated science-basic electronics. Materials which were used were: plywood, hammer, saw, nails, empty packing case, dry cells, connecting wire, switch, bulb (LED), adhesive ("99" glue), plastic beads, plastic bottle top and pencil. The components were used to mount on measured plywood (250 cm square) to produce light. After the demonstration by the researcher, all participants were made to take out the components and fix them up. The head teacher and five other teachers were able to fix the components right and only one teacher had challenges but he was supported by one of the participants. Below is an example

Figure 1.3 Simple Electrical Circuit simple Electrical Circuit built during the INSET
Adopted from: *mini Science.com*

Next was the evaluation of the training. Areas which were evaluated were: expectation, venue, facilitation, time, content and expectations. Below is a diagrammatical representation of the evaluation:

Table 1.2 Diagrammatical representation of evaluation of the training programme

AREA ASSESSED	**NUMBER OF PARTICIPANTS WHO GRADED POOR**	**NUMBER OF PARTICIPANTS WHO GRADED GOOD**	**NUMBER OF PARTICIPANTS WHO GRADED VERY GOOD**	**NUMBER OF PARTICIPANTS WHO GRADED EXCELLENT**
Expectation	0	0	1	6
Venue	0	1	2	4
Facilitation	0	0	0	7
Time	0	2	3	2
Content	0	0	0	7
Participation	0	0	0	7

The researcher thanked all participants for spending time to take part in this refresher training and making it a success.

3.8.3 Activities undertaken for objective three

Objective three was to pre-test the developed circuit board on the teaching and learning of integrated science at Pong-Tamale Experimental primary school. The developed interactive circuit board was pre-tested in three classrooms. Demonstration lessons were organised for upper primary school pupils using the materials. Improvisation is the act of creating artworks, problem solving, or reacting in the moment and in response to the stimulus of one's immediate environment and inner feelings. In a classroom situation, teaching in which a teacher discovers that a particular piece of instructional media needed for effective delivery of a lesson is not available. If the teacher is able to devise or create a suitable substitute for it, the substitute is an improvised instructional media (Adu & Adu, 2014). According to Abbott (2009), as cited by Adu and Adu (2014), Improvisation as a concept can be defined as a technique of originating a totally new tool, instrument, material, devise or modifying existing ones for serving a particular function. For the teacher to be able to improvise, he must be innovative, resourceful and creative in both thinking and manipulative dexterity. That was basic 4 "A", basic 5 "B" and basic six "A". Teachers in these classes have undergone refresher training on the development of the circuit board for teaching integrated science. Observation made in the three classrooms is explained below:

In basic 4"A", the teacher introduced the lesson by reviewing pupils relevant previous knowledge on energy. He linked that to electrical circuit. He took pupils through how to fix the design interactive circuit board. At this point, pupils upon seeing the materials on the table were happy and the whole class was quite. This sustained pupil's interest throughout the lesson. Time was given to pupils to assemble the circuit board in groups. The teacher explained the functions of the various parts of the circuit board. He used this as an opportunity to teach pupils the concept of closed and opened

circuits and how heat energy is converted to electrical energy. The teacher evaluated pupils through oral and writing questions. The oral questions were for pupils to mention parts and functions circuit board and the written one was to draw the circuit board and label all the parts. At the end of the evaluation, 41 pupils out of 45 pupils scored all the marks and that was impressive. After the lesson the researcher and the teacher had a discussion on the lesson. He admitted that the presence of the material has made his lesson delivery very lively and pupil's participation was also excellent.

The case was not too different in class 5 "B" and 6 "A". In class five, the teacher introduced the lesson in a different way. He asked pupils to mention the parts of electrical circuit since they were taught in basic 4. A few of the pupils were able to mention the basic components of the electrical circuit. He then introduced the concept of a circuit board and displayed the materials on the table. He took pupils through how to bring the various components together to produce light. Pupils were excited since they were also allowed by the teacher to try their hand-on the materials. Hence, the lesson was successful since 39 out of 41 pupils were able to answer questions correctly. The teacher did admit that the improvised TLM has helped in capturing the attention of the pupils and therefore less time was used to achieve the objective of the lesson.

In basic 6"A", the teacher introduced the lesson by sending pupils outside the classroom for natures walk. He asked pupils to look round to see at least one object in the environment. The teacher asked them to mention the names of the objects observed. He further asked them to close their eyes. He asked them what they see and they respondent that they could not see anything. He again asked them to mention what made them to see the objects? Most of them said light. He then told them that the topic for the day is electricity. He then sent pupils to the classroom and introduced the components of electrical circuit and how local materials could be used to develop a

circuit board. The teacher demonstrated how to assemble the components on a board to produce electricity. Pupils were put into groups to have hands on the material and they very happy.The lesson was then summarised and exercises given but the teacher was not able to mark and provide feedback to pupils because of heavy rain during that time. Hence, the researcher made a follow up the following two days to find out how the teacher evaluated the pupils. Out of 48 pupils in the class, 43 pupils scored above average and that was remarkable. The teacher admitted that the lesson was different from other lessons because of the materials used. All the teachers then realised that as teachers, they need to cultivate the spirit of improvisation in order to achieve objectives for teaching and learning.

3.9 Data quality and ethical issues

An introductory letter from the Graduate studies, University for Development Studies, Faculty of Education was submittedto the headteacher of Pong-Tamale Experimental School before embarking on the research work. Participants were allowed to express themselves through unstructured interview to ensure the quality of the data. This made respondents express themselves well during the interview sessions. Adequacy and accuracy of the sample size was ensured. The researcher took one class in the upper primary department, the teachers in the upper primary and the head teacher of the school. This sample was chosen to be able to study deep into the problem.

The researcher asked permission from the head of the sample school through formal writingbefore embarking on administering of the research instruments because of ethical issues.The researcher also ensured participants about confidentiality of any information that they gave. This was done through an interview guide. Permission was also sorted before embarking on the observation process since. References was also properly made through the use of N-note software.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Chapter overview

The researcher organised refresher training for teachers on how to develop a circuit board from locally available materials for teaching and learning of basic electronics at Pong-Tamale Experimental primary school in Savelugu-Nanton Municipality. This chapter takes a look at demographic characteristics of respondents, results analysis of the pre-intervention, post intervention results and the challenges that hindered the effective implementation of the refresher training organised during the intervention process.

4.1 Demographic Characteristics of Respondents

In this study, personnel characteristics of respondents have very vital role to play in expressing and giving the responses about the problem. Keeping this in mind, a set of personal characteristics namely, gender, age, qualification, rank, years of teaching experience and years of teaching science at the upper primary school of the 8 respondents have been examined and presented in this chapter. Age of the respondents is one of the most important characteristics in understanding their views about the problem.Age indicates level of maturity of individuals which means that age is more important to examine in this study.

- **Demographic Characteristics of Teachers**

The following areas were taken into consideration during the interview session of teachers at the upper primary school in Pong-Tamale Experimental primary school: gender, their ages, qualification, rank, years of teaching experience and years of

teaching science at the upper primary school. Out of the six teachers, five of them were male science teachers and only one female teacher. Their ages ranged from 28 to 41 years. Two teachers had diploma in Basic Education and four teachers had Bachelor's degree in Basic Education. Only two teachers were trained as science teachers, two specialised in social studies and the other two did home economics as their elective areas. One teacher had 18 years of teaching experience; two teachers had 15 and 16 years of teaching experience, two teachers had 7 years of teaching experience and one teacher had only two years of teaching experience. Four teachers have being teaching integrated science at the upper primary school for 3,5, 7 and 8 years respectively, one teacher has being teaching integrated science at the upper primary for one year and the other teacher had two years teaching experience of science at the primary school.

- **Demographic Characteristics of Head Teacher**

Demographic characteristics considered for the head teacher in the selected school were: gender, age, qualification, rank, years of teaching as a teacher and years of experience as a head teacher. The head teacher was a male teacher and 40 years of age. His qualification was Bachelor degree in basic education and also occupied a rank of principal superintendent. He has being teaching for 15 years and 9 year as a head teacher.

- **Demographic Characteristics of the Circuit Supervisor**

The circuit supervisor was a male and 48 years of age. He holds a Master's degree in social administration and a rank of assistant director II. He has 21 years of teaching experience and also 6 years' experience as a circuit supervisor in Savelugu-Nanton Municipality.

4.2 Discussion of Pre-Intervention and Post Intervention Results.

Below are the findings for the Pre-Intervention and Post Intervention Results:

- **Discussion of Pre-Intervention Results**

Before the intervention, the researcher carried out a series of interviews and observations about the state of the identified problem. Three different sets of unstructured interviews were carried out. One of the interviews was with the head teacher of the selected school. Findings from the interview revealed that most teachers do not use TLMs in their lesson delivery and even the few that use TLMs depend largely on the pictures in pupil's text book, a few sophisticated TLMs provided by GES and other NGOs and chalkboard illustrations. According to the head teacher, some usually state the TLMs in their lessons but sometimes fail to discuss how to use them in the teacher learner activities column in their lesson plans. He also added that a series of School-Based In-service Training have already been organised but TLMs preparation and usage which forms one of the components for teaching and learning has not been considered yet.

The next interview was also with the six teachers. From their submissions, it was evident that most of them lack the spirit of using self-made materials (locally available materials) to support the few sophisticated materials available for teaching and learning. Some of them remarked that it is always time consuming and tedious to prepare TLMs since lesson notes preparation is already spending much of their time. The final interview was for the circuit supervisor. The date settled for the circuit supervisors interview could not come off due to an equally assignment given to him by the Municipal Director. A different date was set for the interview. According to him, there is always an emphasis on the use of locally available materials to support teaching

and learning during his regular monitoring and supervision to schools but most teachers failed to toe to this directive. He said plans have being made to organise training for teachers on TLMs preparation and usage any time there is funding.

Observation was also made in the upper classes to see how teachers deliver lessons in the classroom. Findings from the observation confirmed that some teachers actually teach using chalkboard illustrations and pictures from pupil's text books. Others teach using the lecture method which affects children understanding of concepts and ideas. It was only the basic 5 teacher who brought in a few TLMs to the class but the use of it was not effective because of the large class size. Hence, the researcher observed that teachers lack the skills of preparing TLMs using materials from the immediate environment and that prompted the researcher to organise the refresher training for upper primary teachers on developing a circuit board from locally available materials for teaching of basic electronics (simple electrical circuit).

- **Discussion of Post-Intervention Results**

After the intervention (the refresher training for upper primary school in the selected school), the material developed was used to test its suitability for teaching basic electronics at the upper primary school. Lessons were observed on how the developed interactive circuit board could be used to teach "building of simple electrical circuit". Observation showed that pupil's participation was very encouraging and teachers used limited time to teach the concept of basic electronics. Pupils were allowed to interact with the materials in groups and they were very happy when they connected the various components to produce light. Teachers were able to explain to pupils the components and how they function by feeling them with their hands. All the pupils were very quiet and engaged during the assembling of the components on the board. After the lessons,

an evaluation exercises were conducted in all the classes. Pupils were able to answer both oral and written question correctly. Hence, post-intervention showed that teachers have seen the significance of improvisation and the training has helped to develop teachers professionally and that has also been translated in the pupil's performance. Hence, improvisation plays a very significant role in teaching and learning. According to Adu and Adu (2014:16), they are of the view that through improvisation, learners' attention are captured and retained for the better part of the lesson. Since they serve as educational media, students' interest in science and technology education is stimulated, meaningful and interesting. Learning is more permanent and there is development of skill in the psychomotor domain. Therefore, teachers should always make conscious effort to make good use of locally available materials to enhance lesson delivery.

4.3 Challenges that Hindered the Effective Implementation of the Refresher Training (Limitations)

Below are the challenges that hindered the effective implementation of the refresher training:

- **Time.**

Timing affected the effective implementation of the training. The training was re-scheduled to take place in the afternoon instead of the morning since the head teacher did not want teachers to loss two days contact hours with pupils. Hence, this affected the smooth organisation of the training since some of the teachers have to take their children home after school before returning to the training venue which made them to report late.

- **Finance.**

Money for purchasing of materials and teachers refreshment was a challenge that hindered the effective implementation of the refresher training. Due to this limited

funds, materials were not adequate since some of the materials have to be bought in the market. Their refreshment too was also inadequate due to inadequate funds.

- **Phone calls**

Phone calls affected the training since some of the teachers were coming out to receive calls although all agreed to put all phones on silence. This attitude of some of the teachers affected the smooth implementation of the training programme.

- In administering of the interview guide and the document review, two out of the six teachers were not ready to provide information for the fear of being punished by their superiors even though they were assured of the confidentiality of the information. This was also a challenge.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0 Introduction

The researcher conducted refresher training on the use of locally available materials to build a circuit board for teaching basic electronics at the upper primary school in Pong-Tamale Experimental primary school. This chapter takes a look at summary of the research findings, conclusion and recommendations for further research.

5.1 Summary

This research was determined to equip upper primary teachers through refresher training on how to use locally available materials to build a circuit board for science education (basic electronics) at Pong-Tamale Experimental primary school in Savelugu-Nanton Municipality. The objectives which guided the research were to use locally available materials and develop them into a circuit board for teaching and learning of integrated science at Pong-Tamale Experimental primary school, to train teachers on how to use the developed circuit board to teach integrated science at Pong-Tamale Experimental primary school, and to pre-test the developed circuit board on the teaching and learning of integrated science at Pong-Tamale Experimental primary school. The researcher used action research approach and adopted the qualitative design and also adopted the descriptive method using interview, observation and document review as research tools.

- **Main Findings of the study**

The study found out that pupils' performance in Integrated Science was not encouraging. This was noticed through interview with teachers and head teacher,

observation of lessons and document review. This was evident when the researcher observed a number of lessons at the upper primary school. Observation of lessons showed that most teachers depend solely on pictures in pupils' text books and chalk board illustrations as TLMs for delivery of lessons. Interview with respondents also revealed that teachers lack the competencies needed to improvise TLMs to support lessons delivery. This prompted the researcher to organise refresher training for science teachers at the upper primary school in the selected school to equip them with the knowledge of improvisation to be able to handle basic electronics at that level.After the training, the researcher organised the teachers to pre-test the developed interactive materials in their various classrooms. This was done to ensure the appropriateness of the material to the level of the beneficiaries that is the pupils. Results after the lessons indicated that pupils' attention was captured in the lesson, the usual noise in the class was not realised, children were actively engaged in the learning process and above all pupils were able to answer both oral and written questions.

Hence, the interactive material prepared was appropriate and the results also indicated the significance of using teaching and learning materials for lesson delivery in integrated science. Again, happiness exhibited by pupils during the use of the developed materials proved that science education can be enhanced if appropriate TLMs are used during science lessons and this will help increase pupils curiosity and it will develop pupils' interest for pursuing science at the higher levels.

5.2 Conclusion

The researcher organised refresher training for upper primary teachers on the use of locally available materials to develop a circuit board for science education Pong-Tamale Experimental primary school. Though the study was done in one selected school, the study painted a picture that science education in Ghanaian schools is not

interactive and pupils perform poorly in the subject. Inadequate materials due to teachers not realising the significance of improvisation affects the delivery of science lessons in our schools. This attitude of some teachers makes some teachers skip some topics in the subject; hence pupils perform poorly because almost all lessons are taught in abstract.

Hence, teachers should make good use of materials available in the immediate environment in order to achieve objectives set. It was also realised that regular in-service trainings are not organised in our schools most especially TLMs preparation and usage. Therefore, teachers should realise the value of these local resources to make science education more interesting for pupils in our schools.

5.3 Recommendations

The following recommendations can help improve the state of science education in our schools in Ghana

1. The use of locally available materials to support teaching and learning should be encouraged in all our schools. Teachers can engage some of the pupils to pick waste materials as teaching aids. This will ensure participatory nature of teaching and learning process in our schools in Ghana

2. Monitoring and supervision should be properly done to ensure that teachers use TLMs effectively to support lesson delivery in our schools.

3. PTA/SMC, NGOs and other benevolent organisations should help schools with teaching aids to help supplement the few aids available in the schools.

4. Head teachers should do well and monitor lessons delivery in the schools to ensure that all teachers prepare adequate TLMs for every lesson.

5. Parents and guardians should provide TLMs and past them at their children rooms for their children to be motivated to learn at home.

6. Finally future researchers may also work on the impact of teacher professional development on other subjects. This may help in improving pupils performance in all subjects.

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APPENDIX A

INTERVIEW GUIDE FOR UPPER PRIMARY SCHOOL TEACHERS ON DEVELOPINGA CIRCUIT BOARD FROM LOCALLY AVAILABLE MATERIALS FOR SCIENCE EDUCATION IN PONG-TAMALE EXPERIMENTAL PRIMARY SCHOOL, SAVELUGU

PART I (a): INFORMATION ON THE SCHOOL

Name of School: ……...

Location of School: ……..

District: …….

Circuit…….

Category of School: (a) Government [ ] (b) Private [ ]

TEACHERS BACKGROUND INFORMATION

i) **Gender:** (a) Male [ ] (b) Female [ ]

ii) **Age:** (a) Below 25 [ ] (b) Between 25and 30 years [ ]

(c) Between 35 and 40 years [ ] (d) Between 45 and 50 years [ ]

(e) Above 50 years[ ]

iii) **Teacher Qualification:** (a) GCE "O" Levels [ ] (b) GCE "A" Levels [ ]

(c) Higher National Diploma (HND) [ ] (d) Diploma in Basic Education (DBE) [ ]

(f) Bachelor / Post-Graduate Degree [ ]

Others please specify. .....

iv)**Years of teaching experience:**

(a) Between 1 and 4 years [ ] (b) Between 5 and 8 years [ ]

(c) Between 9 and 12 years [ ] (d) Above 13 years [ ]

v) **Years of teaching science at the Upper Primary School:**

(a) Between 1 and 4 years [ ] (b) Between 5 and 8 years [ ]

(c) Between 9 and 12 years [ ] (d) Above13 years [ ]

PART I (b): QUESTIONS

1. In which class do you teach Science in the Primary school?

(a) Primary Four [ ] (b) Primary Five [ ] (c) Primary Six [ ]

2. Which teaching method (s) do you use?

(a) Lecture Method [ ] (b) Activity Method [ ]

(c) Field trip Method [ ] (d) Demonstration [ ]

 Others, please specify ……..

3. Do you use TLMs during lessons? (a) Yes [ ] (b) No [ ]

4. If yes, who provides the TLMs for?

.....

5. a. Are TLMs available for use in the classroom? a) Yes b) No

i. If yes, do you use the TLMs to teach your lessons? (a) Yes [ ] (b) No [ ]

ii. How do you acquire the TLMs for your science lessons?

(a) Locally made (b) Purchased (c) Self-made (d) GES supply

 Others, please specify. .....

iii. Are TLMs difficult to come by?

Please explain your answer…….....

iv Have you attended any training workshop on TLMs preparation and usage?

(a) Yes [ ] (b) No [ ]

(v) If yes, explain how those TLMs helped you in delivery of your science lessons

.....

.....

Thank You very much for your time

APPENDIX B

INTERVIEW GUIDE FOR HEAD TEACHER ON DEVELOPING A CIRCUIT BOARD FROM LOCALLY AVAILABLE MATERIALS FOR SCIENCE EDUCATION IN PONG-TAMALE EXPERIMENTAL PRIMARY SCHOOL, SAVELUGU

PART I (a): INFORMATION ON THE SCHOOL

Name of School: ……...

Location of School: ……...

District……

Circuit……..

Category of School: (a) Government [ ] (b) Private [ ]

HEADTEACHER BACKGROUND INFORMATION

i) **Gender:** (a) Male [ ] (b) Female [ ]

ii**) Age:** (a) Below 25 [ ] (b) Between 25 and 30 years [ ]

(c) Between 31 and 40years [ ] (d) Between 41 and above [ ]

QUESTIONS

1. a. Have you receive science training on TLMs preparation and usage? (a) Yes [ ] (b) No [ ]

b. If yes, what was the content of the training?

2. How do you organise SBI/CBI in your circuit/school?

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

b. What is your view on science education in primary schools? .....

4. As a public school, how do teachers teach integrated science in your school? .....

5. What qualification do your science teachers have? .....

6. a. Do you have TLMs for science education in your school? (a) Yes [ ] (b) No [ ]

b. If yes, how did you acquire the materials? .....

7. What kind of TLMs do use in the school? .....

8. How often do you monitor science lessons in the school? (a) Daily (b) Weekly (c) Monthly

9. a. Do you motivate teachers who teach with adequate TLMs? (a) Yes [ ] (b) No [ ]

b. If yes, what do you use to motivate them?

.....

10. What efforts does the school make to improve Science education in the Upper primary?

.....

Thank you very much for your time

APPENDIX C

INTERVIEW GUIDE FOR THE CICUIT SUPERVISOR ON DEVELOPING A CIRCUIT BOARD FROM LOCALLY AVAILABLE MATERIALS FOR SCIENCE EDUCATION IN PONG-TAMALE EXPERIMENTAL PRIMARY SCHOOL, SAVELUGU

PART I (a): INFORMATION ON THE CIRCUIT

Name of Circuit: ……...

Location of Circuit: ……...

Number of schools in the circuit……

CIRCUIT SUPERVISOR'S BACKGROUND INFORMATION

i) **Gender:** (a) Male [ ] (b) Female [ ]

ii**) Age:** (a) Below 25 [ ] (b) Between 25 and 30 years [ ]

(c) Between 31 and 40 years [ ] (d) Between 41 and above [ ]

iii) Years of teaching experience……..

iv) Number of years as a circuit supervisor……..

QUESTIONS

1. How often do you visit each school in a term? (a) Two times (b) Three times

2. In your Opinion, what is science education in the basic school?

3. a, Do teachers teach integrated science with TLMs during your monitoring and supervision? (a) Yes [ ] (b) No [ ]

b. Give reason for your answer

4. Does the directorate supply TLMs to schools? (a) Yes [ ] (b) No [ ]

5. How often does the GES supply TLMs?

6. Do you encourage the schools to use materials in the immediate environment to support teaching and learning? (a) Yes [ ] (b) No [ ]

7. a. Does the GES organise refresher training for teachers TLMs preparation and usage on integrated science? (a) Yes [ ] (b) No [ ]

b. If yes, how often are these trainings organise? (a) Once a term (b) Twice a term (c) None

8. In your opinion, what is the significance of refresher training?

……

9. a. Do you think teachers in your circuit teach integrated science with the required TLMs? (a) Yes [ ] (b) No [ ]

b. Give reason(s) for your answer…….....

10. a. Do teachers prepare comprehensive lesson notes for teaching of integrated science? (a) Yes [ ] (b) No [ ]

b. Give reason for your answer ……

Thank you very much for your time

APPENDIX D

OBSERVATION CHECKLIST FOR DEVELOPING A CIRCUIT BOARD FROM LOCALLY AVAILABLE MATERIALS FOR SCIENCE EDUCATION IN PONG-TAMALE EXPERIMENTAL PRIMARY SCHOOL, SAVELUGU

Name of School: ……...…….……...

Location of School: ……...…….……..

Class: .....Average age of pupils…….. No. On roll: .....

Date: .....

Steps for Observing the Teaching of Science lessons

1. Topic for the lesson. .....……

2. Objectives of the topic. .....……

3. Teaching method being employed by the teacher.....……

4. TLMs used for the lesson. .....……

5. Type of TLMs being used.

i. Improvised ii. Purchased iii. Locally made

6. Materials used for the IMs. .....……..……

7. TLMs relationship to the topic i) Yes [ ] ii) No [ ]

8. Pupils participation during lesson. …….....

9. Time management of the teacher during lessons .....…….....

10. Evaluation of lesson…….....

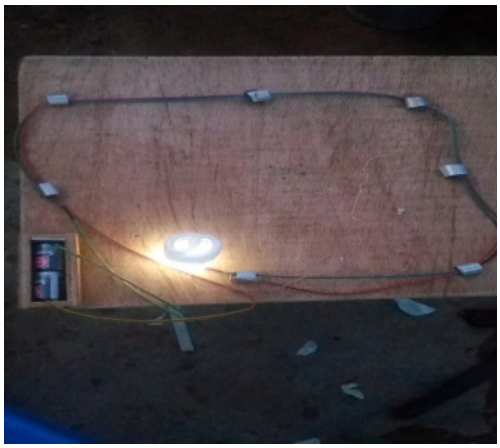
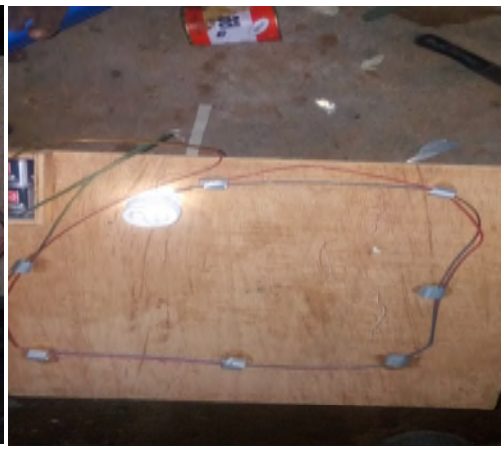
Thank you very much for your time

APPENDIX E

EVIDENCE OF DEVELOPMENT OF TLMs DURING THE INTERVENTION





Production processes of the interactive simple electrical circuit using locally available materials.

A teacher using the developed interactive circuit board to demonstrate to pupils how the simple electrical circuit works.