UNIVERSITY OF EDUCATION, WINNEBA

# EFFECT OF THE USE OF INSTRUCTIONAL RESOURCES ON STUDENTS' PERFORMANCE IN ELECTRICITY AND MAGNETISM

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A DISSERTATION IN THE DEPARTMENT OF SCIENCE EDUCATION, FACULTY OF SCIENCE EDUCATION SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES UNIVERSITY OF EDUCATION, WINNEBA, IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF DEGREE OF MASTER OF EDUCATION, IN SCIENCE EDUCATION.

DECEMBER, 2016

# DECLARATION

**Student**

I hereby declare that except for references to a section of other people's work, which I dully cited and acknowledged, this is a true reflection of my own work and that it has neither in whole or part been presented elsewhere for any award.

**Signature**…………………………………  **Date**…………………………………
Mr Kofi Nagonu

**Supervisor**

I hereby declare that the preparation and presentation of this work was in accordance with the guidelines for supervision of dissertation as laid down by the University of Education, Winneba.

**Signature**…………………………………  **Date**…………………………………
Dr Victor Antwi.

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## DEDICATION

I dedicate this work to God Almighty for His never-ending blessings and also for giving me necessary wherewithal to be able to complete this project work. Also to my entire family especially my mother.

## ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| AAAS | American Association for the Advancement of Science |
| CEP | Center on Education Policy |
| IS | Instructional Resource |
| IM | Instructional material |
| NRC | National Research Council |
| NSF | National Science Foundation |
| NSRC | The National Science Resources Centre |
| NTI | National Teachers Institute |
| SHS | Senior High School |
| UNESCO | United Nations Educational Scientific and Cultural Organization |
| USAID | United States Agency for International Development |

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# ABSTRACT

The purpose of this study was to investigate the effectiveness of the use of instructional resources on the academic performance of students and also how these materials can motivate learners to learn Physics. The study was a quasi- experimental research design that employed pre-test, post-test, unstructured interview and observational technique. The population of the study comprised all Senior High School science students in the Nkwanta South District of the Volta Region of Ghana. The purposive and convenience sampling technique was employed to select the sample for the study. Form three (3B) science class which consist of thirty-seven (37) boys and three (3) girls was selected for the study. The total sample for the study was forty (40) form three (3B) science students of Nkwanta SHS. The data obtained was analysed using SPSS to find achievement mean scores. To see the treatment effect, the mean scores were computed to determine the average achievement on the variable of the pre-test and post-test. In addition, the significance difference between the mean scores was tested at 0.05 level by applying t-test based on the pre-test and the post-test. It was observed that the mean score of the post-intervention test (Mean = 16.70, Sd = 1.977) is much higher than the mean score of the pre-intervention test (Mean = 7.22, Sd = 3.068). Also the total performance scores of the entire sample put together on the post-intervention test (668) was higher than the total scores at the pre-intervention test (289). This implies that there was an improvement in performance of 39.6% during the post-intervention test

This study also showed that significant difference exists between the performance of students taught with instructional materials and those taught without instructional materials. It was recommended that stakeholder should ensure regular provision of instructional materials to the SHSs to enhance teaching and learning of Physics.

# CHAPTER ONE

# INTRODUCTION

## Overview

This chapter contains informations on the background of the study, the statement of the problem, the purpose of the study, the objectives of the study, research questions and the educational significance of the study. Also in this chapter is the delimitation addressed by the study. The chapter ends with the presentation of the operational definitions used in the study as well a description of the organisation of the research report.

## Background of the study

Science had been of great importance internationally for sustainable and socio-economic development as well as for technological advancement of nations. Knowledge of science and technology is therefore a requirement in all countries and needed by all people globally due to numerous challenges that are facing them. These challenges include emergence of new drug resistant diseases, effects of genetic experimentation and engineering, ecological impact of modern technology, dangers of nuclear war and explosions and global warming among others (Alsop & Hicks, 2001; Minish; Muni; Okumu; Mutai; Mwangasha; Omolo; Munyeke. 2004). This had resulted to rapid changes taking place in medicine, industry, communication, and agriculture. Science as an agent of development plays an important role in bringing about these changes through technological advancement, national wealth enhancement, health improvement and industrialization (Validya, 2003). This is why scientific and technological breakthrough is usually the goal of any developing nation like Ghana. Wenham (1984) opined that Physics is and will remain the fundamental science.

Physics is the bedrock of science and technology because many of the tools on which the scientific and technological advancement depends are the direct products of Physics. Physics is therefore a core subject in science and technology since it studies the essence of natural phenomena and helps people understand the rapidly technological changing society (Zhaoyao, 2002). The principles of Physics have been widely used for various economic, scientific and technological advancements such as in information technology, which has reduced the world into a global village through the use of satellites and computers. Also, the knowledge of Physics had led to sustainable development in the area of industrialisation for improvement of materials useful to the wellbeing of human race. Furthermore, Physics education enables the learners to acquire problem-solving and decision-making skills that pave way for critical thinking and inquiry that could help them to respond to widespread and radical changes in all facets of life.

Despite the importance of Physics to the scientific and technological development of our nation, understanding of the subject had dwindled over the years and performance of the enrolled students had not been encouraging. Ho and Boo (2007) discussed that in many countries, there has been a decline in the number of students wishing to continue with Physics. Ogunleye (2000) and Umeh (2002) were all of the opinion that students' performances in the science subjects were poor. Also, previous study had shown that students who hold negative stereotype images of scientists, science and technology in society are easily discouraged from pursuing scientific disciplines and usually performed poorly in science subjects (Changeiywo, 2000). This situation does not favour Ghana's move towards developing a scientific and technological nation.

The influence of instructional materials in promoting students' academic performance and teaching and learning in educational development is indisputable. The teaching of

Physics topics such as Electricity and Magnetism in Ghanaian secondary schools needs to be properly handled. The materials used by teachers to teach and drive home their subject at the primary and secondary school levels of our education system is incontrovertibly a paramount important issue in practical classroom interaction and successful transfer of knowledge from the Teacher to the students. Instructional resources are materials which assist teachers to make their lessons explicit to learners. They are also used to transmit information, ideas and notes to learners. Instructional materials include both visuals and audio-visuals such as pictures, flashcards, posters, charts, tape recorder, radio, video, television, computers, and projectors among others. These materials serve as supplement resources to the normal processes of instruction. Visual aids make lesson come alive and help students to learn better. The importance and technicality of Physics as a subject makes it necessary that relevant instructional materials should be used to teach it to the learners. It is against this background that this study attempts to examine the extent to which the utilization of instructional materials could advance senior secondary school students performance in Physics.

Poor academic achievement in Physics could be attributed to many factors among which teacher's strategy itself is considered as an important factor. This implies that the mastery of Physics concepts might not be fully achieved without the use of instructional materials. The teaching of Physics without instructional materials may certainly result in poor academic achievement. Franzer; Okebukola;.Jegede (1992) stressed that a professionally qualified science teacher no matter how well trained, would unable to put his ideas into practice if the school setting lacks the equipment and materials necessary for him or her to translate his competence into reality.

**Statement of the problem**

The art of teaching is fundamentally concerned with passing ideas, skills and attitude from the teacher to the learner. In Ghana, for example experience has shown that spoken words alone in the communication of ideas are grossly ineffective and inefficient in producing desired learning outcomes. According to chief Examiner's students' performance in examination under review in 2014 and 2015, the West Africa Examinations Council observed such weaknesses among the students as, inadequate grasp of many basic concepts in physics, inability to relate acquired knowledge to real life situations, inability to give acceptable description of laboratory experiment, inability to interpret graphical representation of physical quantities etc. The Chief Examiner suggested that the remedies for these weaknesses among others are; teachers should expose candidates to practical activities early enough, schools to provide enough and functional apparatus in their laboratories and also ensuring adequate provision of teaching and learning materials in schools etc (WAEC, 2014 & 2015). This points to the fact that there are topics in Physics that pose serious problems of comprehension to students. Most especially Electricity and Magnetism. These topics cannot be taught effectively without the use of relevant instructional materials to make the learning practical. Adebanjo (2007) affirmed that the use of instructional materials in teaching and learning of Physics makes students learn more and retain better what they have been taught and that it also promotes and sustains students' interest. It also allows the learners to discover themselves and their abilities. Students learn more when they see what they are being taught. However, the questions here are: does the use of instructional materials really influence students' academic performance? Is teaching effectiveness enhanced by the use of instructional materials? Could students' learning be advanced by the use of instructional materials? Finding answers to these questions and more summarizes the entire problem of this study.

**Purpose of the study**

The purpose of this study is to investigate whether learners will be motivated to learn when instructional materials are used during the teaching and learning process and also to examine the effectiveness of the use of instructional resources on learners' performance in some selected topics in Electricity and Magnetism during science lessons.

**Objectives of the study.**

The objectives of this study.

1. To examine the influence of instructional material utilisation on the teaching of Electricity and Magnetism in Nkwanta Senior High Schools;
2. To determine whether there will be any difference in the academic performance of Nkwanta Senior High schools students in Electricity and Magnetism due to the use of instructional materials.
3. To find out if the use of instructional resources will motivate students to learn Electricity and Magnetism.

**Research Questions**

In order to achieve the objectives of this study, the following research questions were raised to guide the investigation:

1. How will the use of instructional materials influence the teaching and application of Electricity and Magnetism in Senior High Schools?

2. To what extent will the use of instructional materials influence the academic performance of Nkwanta Senior High School students in Electricity and Magnetism?
3. How will the use of instructional resources motivate students to learn Electricity and Magnetism in Nkwanta Senior High School?

**Significance of the study**

The use of instructional materials give the learners opportunity to touch, smell or taste objects in the teaching and learning process. Consequently, knowledge passed unto the students at different levels of educational instructions should be well planned and properly allied with relevant instructional materials for clarity and comprehensibility. Hence the significance of this study to the students, teachers, curriculum planners, educational system and the society at large.

- To the students, the effective use of instructional materials would enable them to learn and retain what they have learnt and thereby advancing their performance in the topic in question. This is because learning is a process through which knowledge, skills, habits, facts, ideas and principles are acquired, retained and utilized; and the only means of achieving this is through the use of instructional materials.
- The study would help enhance teachers' teaching effectiveness and productivity. Consequently a teacher who makes use of appropriate instructional materials to supplement his teaching will help enhance students' innovative and creative thinking as well as help them become plausibly spontaneous and enthusiastic. Teachers who take advantage of these resources and learn to use them correctly will find that they make almost an incalculable contribution to instruction.

- The study is also significant to the educational system and society at large. This is because when teachers solidify their teaching with instructional materials and the learners learn effectively, the knowledge acquired will reflect in the society positively.

**Delimitation**

The scope of the study was to use instructional materials to teach Senior High School students in the Nkwanta South District in the Volta Region. However, due to limited time, only Form Three (B) Science students from Nkwanta Senior High School were used for the study.

**Definition of terms**

**Instructional Resources (IS):** They are materials the teacher uses to make the lesson more interesting and understandable. For the purpose of this study, instructional materials (IMs), teaching and learning materials (TLMs), teaching and learning resources (TLR), instructional media (IMs) and instructional Technology (IT) will be used alongside to mean the same as instructional resources.

**Organisation of the study**

The research work is organised in five chapters; the first chapter is the introductory chapter which gives an account of the background of the study, the statement of problem and purpose of the study. The chapter also includes the research questions raised and delimitation of the study. The second chapter is made up of review of literature on the topic under study while chapter three describes the methods and techniques used to collect and analysed data. The fourth chapter is about data presentation and discussions of the research findings. Chapter five which is the final chapter is made up of summary, conclusions, recommendations and suggestions to the use of instructional materials to enhance students' performance in the various science concepts especially in Electricity and Magnetism in Nkwanta Senior High School.

# CHAPTER TWO

# LITERATURE REVIEW

## Overview

New research findings are built and shaped by existing theories. For this reason, every scientific research contains a chapter devoted for the re-examination of theories and other research findings that are related to its purpose and objectives. This chapter therefore discusses related literature in the areas of meanings of instructional materials or resources, classification of instructional resources, justification of the use of instructional resources, selection of instructional resources, application of instructional resources, importance of instructional resources, conceptual frameworks of the study.

Teaching at any level requires that the students be exposed to some form of simulation. Physics as a science subject is activity oriented and the suggested method for teaching it which is guided discovery method is resource base (NTI, 2007). This suggests that the mastery of Physics concepts cannot be fully achieved without the use of instructional learning materials. The teaching of Physics without learning materials will certainly result in poor performance in the course. Franzer, Okebukola, Jegede and others (1992) stressed that; a professionally qualified science teacher no matter how well trained would be unable to put his ideas into practice if the school setting lacks the equipment and materials necessary for him or her to translate his competence into reality. This suggests that for teaching and learning of Physics to be fully materialized, there would be the need of the use of instructional resources or materials. This can be achieved through the use of computer simulations or computer assisted instructions, charts, overhead projectors, video, properly organized practical activities etc.

In order for students to understand new ideas or concepts and construct their own knowledge, they need to see clear examples of what the new ideas or skills represent (Rosenshine, 1997; Trowbridge, Bybee, & Powell, 2000). Furthermore, in learning new materials or skills, students should be given extensive opportunity to manipulate the environment (Joyce, Weil, & Calhoun, 2000) as, according to Piaget (1987), students' cognitive structures will grow only when they initiate their own learning experiences. For example, Rosenshine (1997) suggests that teachers should provide tasks where students can engage in cognitive processing activities of organizing, reviewing, rehearsing, summarizing, comparing, and contrasting with other students, or with the teacher or working alone. In addition, teachers should encourage informal discussions and structured science activities so that students are required to explain and justify their understanding, argue from the data, justify their conclusions and critically assess the scientific explanations of a matter (Abrams, 1998).

Whilst the value and purpose of practical work has been continuously debated, it has nevertheless remained core component of school science education. Indeed, the inclusion of practical work within an academic subject is a significant feature that distinguishes science from the majority of other subjects in secondary schools (Sharpe, 2012). The use of practical work in schools is clearly recognized as important, yet remains rather a typical in terms of the quantity and amount of time devoted to it compared to some other countries (Bennett, 2005; Woolnough, 1998). For most teachers, practical work encompasses what teaching and learning science is all about (Woodley, 2009).

As Abrahams and Millar (2008) indicate, many teachers view practical work as central to the appeal and effectiveness of science education. Indeed, reference is often made to the adage, 'I hear and I forget, I see and I remember, I do and I understand' written originally by Confucius as cited in Sharpe (2012). Klassen (2009) identifies three essentials aspects, which could be generalized to most pupil oriented science experiments; (1) exposing the difficulty in obtaining experimental results if the scientific method behind the experiment is strictly followed, (2) dealing with the difficult nature of the science behind the experiment, and (3) establishing the experiment outcome.

Through practical work, the pupils' knowledge and understanding of science is likely to be increased (Wellington, 2005), but it is important to distinguish between "knowledge", "knowledge how" and "knowledge why". Engaging in practical activities improves pupils' knowledge of what happens and how it happens. Understanding why is not the pupils' "discovery" behind the experiment, but self-reflecting on the experimental work already done.

Learning through practical work and experience is very important in science lessons. Research on the effect of using live animals in the classroom on pupils' perception of the animals showed that, in comparison to other approaches, pupils get a better attitude and long lasting knowledge about the living organisms (Tomažič, 2009), they experiment without the teacher's intervention (Tomkins and Tunnicliffe, 2001) and also invent and unify their own terminology while reporting on the experiment. In general, pupils are intrinsically motivated towards learning, but not also for explaining abstract experimental observation (Juriševič, Glažar, Pučka, & Devetak, 2008). Pupils show interest in more concrete content, while abstract content gives rise to anxiety.

For effective learning to occur, teachers should first identify students' prior ideas, make students aware of them and, in the light of these ideas, help students construct their own understanding by allowing them to practice them. After that teachers should provide opportunities for students to apply their newly acquired knowledge to different situations.

According to Joyce, (2001), during the preschool and kindergarten years, learners add to what they have learned in the early explorations as learners' expands. The environment plays a critical role, the richer the environment the more concrete opportunities there are for learners to learn by interacting with IM. Teacher's role is to create an environment that invites learners to observe, to be active, make choices and to experiment Judy (2001). Judy further states that IMs are tools used for teaching and learning hence, supports the teacher in delivery of knowledge or help to emphasize specific knowledge. According to Thungu (2008), IM meet the needs of learners, fulfil the requirements of the subjects and facilitate the teaching and learning process.

**Meaning of Instructional Materials**

Instructional materials are materials or tools locally made or imported that could made tremendous enhancement of lesson impact if intelligently used (Isola, 2010). They are objects or devices, which help the teacher to make a lesson much clearer to the learner. Instructional materials are didactic materials things which are supposed to make learning and teaching possible. Instructional materials include all materials including instruments and resources that aid the teacher in realizing his/her objectives in the teaching-learning process. These include textbooks, charts, improvised workbook and so on (Ifeoma, 2013).

Instructional resource materials are all teaching assisting materials either imported or locally made that aid in teaching. They are resources which the teachers use to enhance learning, understanding and facilitate the acquisition of concepts, principles and skills by students. Isola (2010) also referred to them as objects or devices, which help the teacher to make lesson much clearer to the learner. Instructional materials are also described as concrete or physical objects which provide sound, visual or both to the sense organs during teaching (Agina-Obu, 2005).

Instructional materials are materials which assist teachers to make their lessons explicit to learners, they are devices which present a complete body of information and largely self-supporting rather than supplementary in teaching and learning.

**Classification of instructional Resources (materials)**

Instructional materials can be grouped under the headings; Visual Materials, Audio-Aids, Audio-Visual Aids and Community Resources.

Visual Materials: science laboratory equipment, 3-dimensional objects, models, specimen, Textbooks, workbooks, Chalkboards, Projected slides, Film strips, and overhead projectors.

Audio-Aids: Radio, Record player and Tape recorders

Audio-Visual Aids: Motion pictures, Television, Computer Conferencing, Video, Libraries etc.

Instructional materials are visual and audio-visual aids, concrete or non-concrete, used by teachers to improve the quality of teaching and learning activities in Social Studies. Instructional materials are tools used by teachers to aid explanations and make learning of subject matter understandable to students during teaching learning process (Oluwagbohunmi & Abdu-Raheem, 2014).

According to (Oladejo, Olosunde, O., Ojebisi, & Isola, 2011) instructional materials are in various classes, such as audio or aural, visual or audio-visual. Thus, audio instructional materials refer to those devices that make use of the sense of hearing only, like radio, audio tape recording, Visual instructional materials on the other hand, are those devices that appeal to the sense of sight only such as the chalkboard, chart, slide, and filmstrip. An audio-visual instructional material however, is a combination of devices which appeal to the sense of both hearing and seeing such as television, motion picture and the computer. Among the instructional materials the classroom teacher uses, the visuals out-numbered the combination of the audio and audio-visual.

**Importance of Instructional Resources (materials)**

Teaching is not complete until knowledge has been successfully transferred which in most cases may not just be tied to teacher effectiveness or teaching skill but the instructional materials used in the learning process. According to Jimoh(2009), ordinary words or verbalization has been found to be inadequate for effective teaching. Instructional materials serve as a channel through which message, information, ideas and knowledge are disseminated more easily. They can therefore be manipulated, seen, heard, felt or talked about. These materials facilitate activities and they are anything or anybody the teacher turns to for help in learning process.

Adekunle (2008) as cited in Okobia (2011) noted that teaching resources in social studies means anything that can assist the teacher in promoting teaching and learning. When the students are given the chance to learn through more senses than one, they can learn faster and easier. The use of instructional materials provides the teacher with interesting and compelling platforms for conveying information since they motivate learners to learn more. Furthermore the teacher is assisted in overcoming physical difficulties that could have hindered his effective presentation of a given topic. Larson (2001) quoted Lane (1994) who noted that the use of electronically mediated instruction to duplicate the traditional face to face classroom has resulted in a shift from teacher- to student-centred classes. In this situation the responsibility for learning is shifted to the students. The teacher facilitates the learning by acting as a coach, resource guide and companion in learning. The use of instructional materials does not only encourage teachers and students to work collaboratively but also results in more cooperative learning activities among the students.

Fadeiye (2005) posits that instructional materials are essential and significant tools needed for teaching and learning of school subjects to promote teachers' efficiency and improve students' performance. They make learning more interesting, practical, realistic and appealing. They also enable both the teachers and students to participate actively and effectively in lesson sessions. They give room for acquisition of skills and knowledge and development of self- confidence and self- actualization

Utilization of instructional materials is a tool and strategies for improving teacher professional development for effective service delivery (Nwosu, 2010). Based on the meaning given to utilization, it has been observed that mastery of subject matter might not be fully achieved without the use of instructional materials. As such, teaching without instructional materials may certainly result in poor academic achievement.

When students' academic performance for ten years was studied in relation to the use of instructional materials in Kwara State, Isola (2010) established that there was a strong correlation between the utilization of instructional materials and students' academic performance in many subjects. (Oladejo, Olosunde, Ojebisi, & Isola, 2011) asserted that there is a significant difference in the academic performance of students taught Physics using standard instructional materials, those taught with improvised instructional material and those in the conventional instruction. Where those taught using standard instructional materials performed better than those taught using conventional instruction. Non availability and inadequacy of instructional materials are major causes of ineffectiveness of the school system and poor performance of students in schools (Abdu-Raheem, 2011).

Instructional materials help teachers to teach conveniently and the learners to learn easily without any problem and they have direct contact with all sense organs (Olumorin, Yusuf, Ajidagba, & Jekayinfa, 2010). Effective teaching and learning requires a teacher to teach the students with instructional materials and use practical activities to make learning more vivid, logical, realistic and pragmatic (Akinleye, 2010). It has been established by Olayinka (2016) that students taught with instructional materials have excellent achievement scores compared with those taught without any material. She further affirmed that importance of instructional materials in the development of learners' intellectual abilities and attainment of teaching/learning objectives cannot be over emphasized. There is statistical significant difference in the academic performance of students taught with instructional materials than those not taught with them (Ifeoma, 2013). It was also established that the use of instructional materials such as workbooks improved the quality of learning in the students.

Instructional materials stimulates and helps learners to take active interest in the topic presented, development of emotional impact of the learners and affect their attitude towards what is portrayed. The usefulness of these materials depends on what the facilitators make out of them (Mba, 2004). Unless the facilitators use these materials and direct learners attention to what they should look for, the learners will not learn as intended from such materials. Instructional materials result in more effective learning of actual information in less time than voicing

**Instructional Materials and Students' Academic Achievement**

There have been several studies on instructional materials and academic achievement. For instance, Adeogun (2001) discovered a very strong positive significant relationship between instructional resources and academic performance. According to Adeogun, schools endowed with more materials performed better than schools that are less endowed.

Lyons (2012) states that learning is a complex activity that involves interplay of students' motivation, physical facilities, teaching resources, and skills of teaching and curriculum demands. Availability of TLR therefore enhances the effectiveness of schools as they are the basic resources that bring about good academic performance in the students.

Studies done in the past on the relationship between TLR and performance include, Likoko, Mutsotso, and Nasongo (2013) in the study on adequacy of instructional materials and physical facilities and their effect on quality of teacher preparation in colleges in Bungoma county and a study done by Mbaria (2006) on the relationship between learning resources and performance in secondary schools in Ndaragwa district. All the above studies indicate that TLR were higher in higher performing schools than in low performing schools and that there is a significant difference in resource availability in the higher performing schools and low performing schools. Also indicate that most institutions are faced with challenges such as lack of adequate facilities like libraries and inadequate instructional materials and these factors tend to have a negative effect on the quality of graduates produced.

TLR help improve access and educational outcomes since students are less likely to be absent from schools that provide interesting, meaningful and relevant experiences to them. These resources should be provided in quality and quantity in schools for effective teaching-learning process. Several studies have been conducted on the impact of instructional materials on education.

According to Phyllis (2011) as cited in Wambui (2013), instructional materials possess some inherent advantages that make them unique in teaching. For one thing, they provide the teacher with interesting and compelling platforms for conveying information since they motivate learners to want to learn more and more. Also, by providing opportunities for private study and reference, the learner's interest and curiosity are increasingly stimulated. Additionally, the teacher is assisted in overcoming physical difficulties that could have hindered his effective presentation of a given topic.

They generally make teaching and learning easier and less stressful. They are equally indispensable catalysts of social and intellectual development of the learners. Bolick, Berson, Coutts, and Heinecke (2003) pointed to a good relationship between effective teachings and using of instructional materials. He argued that while some educators have been fascinated by the potential of instructional materials to enhance teaching and learning, teachers lagged behind in using instructional materials during teaching and learning. Others expressed doubts that instructional materials will ever incite teaching reform on "participation". Instructional materials are integral components of teaching-learning situations; it is not just to supplement learning but to complement its process. It then shows that, if there must be an effective teaching learning activity, utilization of instructional materials will be necessary Kibe (2011) as cited in (Wambui, 2013).

**Use of IM on Teaching and Learning: Global Perspective**

In January 2002, the U.S. Department of State's U.S. Agency for International Development (USAID) announced its intent to move quickly to make visible progress in the reconstruction of Afghanistan. One of the first efforts was to be the provision of 9.7 million science, math, and reading textbooks for Afghan students in grades by the start of their school year in March 2002. First Lady Laura Bush noted, "Nothing is more important to Afghanistan's future than giving its children the tools and skills they need to learn and succeed" (USAID, 2002). UNESCO asserts, improvement in the quality of education depends to a great extent on whether relevant and high quality books and other learning materials can be made available to teachers and students (United Nations Educational Scientific and Cultural Organization). As UNESCO notes in its Basic Learning Materials Initiative, textbooks provide the main resource for teachers, enabling them to animate the curricula and giving life to the subjects taught in the classroom (UNESCO, nd).

In an analysis of the impact of computers on eighth grade math scores, Wenglisky (1998), found that the largest positive effect comes from teachers using computers primarily for simulations and applications.

In science, learning materials and workspaces that permit "hands-on" science activities are increasingly necessary for student achievement in inquiry-based science education (National Research Council, 1996; Von Secker & Lissitz, 1999). Von Secker and Lissitz' analysis of data from the 1990 High School Effectiveness Study (1999) found that opportunities for laboratory inquiry lead to higher achievement and more equitable achievement among students of different socioeconomic backgrounds,

Krajcik, Reiser, Moje and Marx (2003) noted that research-based curriculum materials can address these challenges and provide improved tools for learning among teachers and students through development of appropriate instructional designs. Instructional materials can serve as learning materials for both students and teachers. Materials can also serve as a primary influence on how teachers should teach science (Krajcik, Reiser, Moje, & Marx, 2003). Yandila, Komane, and Moganane (2003) quoted teachers as facing difficulties in implementation of learner-centred approach due to, among other factors, lack of exemplary teaching materials and inappropriate textbooks.

## IMs and Students' Motivation

Educational psychologists have long recognized the importance of motivation for supporting student learning. For this reason many researches have been conducted to ascertain the impact of motivation on leaners academic performance.

## What is motivation and why does it matter?

Almost anyone can give an anecdotal example of a family member or friend who is smart, possibly even scores highly on tests, but never cared to engage in school and never got good grades. Why would such an intelligent child lack the drive to excel? Or what explanation is there for two siblings raised in the same household, one of whom is extremely academically driven and the other of whom doesn't seem to care about academics at all? These are complex questions with no easy answers. But fundamentally, they point to one important issue, students' motivation to learn (Center on Education Policy (CEP ), 2012).

Education reform advocates have dedicated huge amounts of time and energy to improving public schools and raising student achievement. But with attention currently focused on factors like improving teacher quality, overhauling curriculum and standards, and developing new assessments, one major factor is being overshadowed: the motivation of the students themselves. Even with the best administrators, faculty, curriculum, and materials in place, if students are not motivated to learn and excel, achievement gains will be difficult, if not impossible. Higher motivation to learn has been linked not only to better academic performance, but to greater conceptual understanding, satisfaction with school, self-esteem, and social adjustment, and to lower dropout rates (Gottfried, 2009; Gottfried, 1985; Ryan & Deci, 2009; Ryan &

Deci, 2000). Not only is student motivation the final piece of the school improvement puzzle, without it, the rest of the puzzle falls apart.

Perhaps motivation is less discussed because it is such an amorphous and difficult subject. To even define motivation is challenging, let alone to measure it. To dig beneath the surface and really think about student motivation only brings up more questions. Are there "right" and "wrong" ways to motivate students to learn? Whose job is it to motivate students, and who is responsible when they are not motivated? Can a poorly planned student engagement program actually harm motivation?

**Why Does Motivation Matter?**

**Motivation affects every aspect of schooling**

Although not as frequently discussed as other aspects of reform, motivation is a crucial part of a student's experience from preschool onward. Motivation can affect how students approach school in general, how they relate to teachers, how much time and effort they devote to their studies, how much support they seek when they're struggling, how much they attempt to engage or disengage their fellow students from academics, how they perform on assessments (and therefore how the school performs), and so on. Hardly any aspect of the school environment is unaffected.

**Lack of motivation has important consequences**

Former Education Secretary Terrel Bell made this point forcefully when he said, "There are three things to remember about education. The first is motivation. The second one is motivation. The third one is motivation."

Data indicate that lack of motivation is a real problem affecting large percentages of students. Upwards of 40% of high school students, depending on the study, are disengaged from learning, are inattentive, exert little effort on school work, and report being bored in school, according to a 2004 National Research Council report. Unfortunately, this report noted, motivation and engagement in school decline steadily as students progress from elementary to middle and high school. Adolescents are too old and too independent to follow teachers' demands out of obedience, and many are too young, inexperienced, or uninformed to appreciate the value of succeeding in school (National Research Council ( NRC ), 2004). Losing motivation to learn has serious consequences that can culminate in students dropping out of school. In a 2006 survey exploring why students dropped out of high school, 70% of dropouts said they were unmotivated (Bridgeland, DiIulio & Morison, 2006).

**What is motivation?**

To understand factors that can diminish or strengthen motivation, one must first grasp what is meant by the complex concept of motivation itself. What motivates students to learn? Is it simply the desire to get good grades, or is it a competitive drive to outperform their peers? Or do they want to satisfy some family demand? Is it a fear of failure? Is it a hope to generally succeed in life, whether that means being admitted a top college or getting a certain job? Or is it the promise of concrete rewards that drives them to succeed?

Motivation refers to the reasons underlying behaviour characterized by willingness and volition. (Guay, Chanal, Ratelle, Marsh, Larose and Boivin). Paraphrasing Gredler, Broussard and Garrison(2004) broadly define motivation as the attribute that moves us to do or not to do something. Gottfried (1990) defines academic motivation as enjoyment of school learning characterized by a mastery orientation; curiosity; persistence; task-endogeny; and the learning of challenging, difficult, and novel tasks. On the other hand, Turner (1995) considers motivation to be synonymous with cognitive engagement, which he defines as voluntary uses of high-level self-regulated learning strategies, such as paying attention, connection, planning, and monitoring.

Motivation involves a constellation of closely related beliefs, perceptions, values, interests, and actions. Motivation within individuals tends to vary across subject areas, and this domain specificity increases with age. Motivation in children predicts motivation later in life, and the stability of this relationship strengthens with age (Emily, 2011).

**Motivation can be intrinsic or extrinsic (or perhaps both)**

Researchers who have struggled with questions of what motivates students generally recognize two major types of motivation: intrinsic and extrinsic. Intrinsic motivation is the desire to do or achieve something because one truly wants to and takes pleasure or sees value in doing so. Extrinsic motivation is the desire to do or achieve something not for the enjoyment of the thing itself, but because doing so leads to a certain result (Pintrich, 2003). Some refer to this divide as the difference between true motivation and "engagement," or simply holding one's attention. Others see not a divide but a spectrum; any action could be motivated by a combination of intrinsic and extrinsic factors (Rigby, Deci, Patrick, Ryan and Rigby, 1992; Murray, 2011). It is often difficult, if not impossible, to categorize motivation as purely intrinsic or extrinsic. How can we determine if a student truly wanted to achieve something, if that person simply went through the motions to gain the promised reward, or if it was a mixture of both? Or maybe the student was drawn in by the extrinsic reward, but while going through the motions to earn it, began to see its intrinsic value. Although complex, this concept of intrinsic versus extrinsic motivation creates important questions for the designers of motivation programs.

**Students' beliefs affect motivation.**

As Deci, Koestner and Ryan (1999) observe, intrinsic motivation energizes and sustains activities through the spontaneous satisfactions inherent in effective volitional action. It is manifest in behaviours such as play, exploration, and challenge seeking that people often do for external rewards. Researchers often contrast intrinsic motivation with extrinsic motivation, which is motivation governed by reinforcement contingencies. Traditionally, educators consider intrinsic motivation to be more desirable and to result in better learning outcomes than extrinsic motivation (Deci, Koestner and Ryan, 1999).

Other findings from the fields of psychology and development have implications for policy design. Researchers have demonstrated that how students think of their own capacity to learn can influence how motivated they are (Barry, 2007; Murray, 2011). If a student believes, for whatever reason, that he or she has a limited capacity for learning or feels unlikely to succeed, that student will not be as academically motivated (Pintrich, 2003).

Additionally, how students conceptualize "knowledge" or "learning" can also influence how motivated they are. If a student defines knowledge as a fixed quantity a person either has or doesn't have, that student is less likely to be motivated to learn than one who defines knowledge as a quantity that can change and grow (Dweck, 2010).

Likewise, students need to recognize a correlation between effort and success. Students who feel they have no control over the outcomes of their efforts are less likely to put forth any effort to begin with (Barry, 2007; Murray, 2011; Pintrich, 2003). Some scholars feel that only one of these perspectives is an accurate way to look at motivation, while others believe it is a combination of such influences that motivates students.

**Four major dimensions contribute to motivation**

While researchers use different frameworks for thinking about motivation, they essentially agree on the major factors students need to have in order to be motivated: competence (the belief that they're capable of doing something), autonomy/control (the ability to set appropriate goals and see a correlation between effort and outcome), interest/value (a vested interest in the task and a feeling that its value is worth the effort to complete it), and relatedness (the need to feel part of a group or social context and exhibit behaviour appropriate to that group) (Murray, 2011; Pintrich, 2003; Ryan &Deci, 2000). These dimensions of motivation, which are drawn from the work of several major scholars, are important to understand.

**Table 1. Four Dimensions of Motivation**

| **Four Dimensions of Motivation** | |
|---|---|
| **Dimensions** | **Indicators** |
| Competence<br>(Am capable?) | The student believes he or she has the ability to complete the task. |
| Control/autonomy<br>(Can I control it?) | The student feels in *control* by seeing a direct a link between his or her actions and an outcome.<br>The student retains *autonomy* by having some choice about whether or how to undertake the task. |
| Interest/value<br>(Does it interest me? Is it worth the effort?) | The student has some *interest* in the task or sees the value of completing it. |
| Relatedness<br>(What do others think?) | Completing the task brings the student social rewards, such as a sense of belonging to a classroom or other desired social group or approval from a person of social importance to the student. |

**Sources:** (Bandura, 1996; Dweck, 2010; Murray, 2011; Pintrich, 2003; Ryan & Deci, 2000; Seifert, 2004)**.**

Why anyone does any of the things that they do is difficult to accurately determine. Students' motivation to learn is only slightly less complex. Each of the types and dimensions of motivation described above suggests a slightly different strategy for fostering motivation. If students are best motivated extrinsically, for example, then paying them cash for good grades would be a smart policy. However, if to motivate students we must change their concept of self, then paying for good grades might actually be detrimental.

Even within each individual student, motivation in one class or subject could be completely independent from factors motivating that same student in a different context. Some students may be motivated and sustained through their self-efficacy beliefs, whereas others are motivated to try hard, persist, and achieve because of their goals, their personal interests, their value beliefs or contextual factors (Pintrich, 2003).

Broussard and Garrison (2004) observe that contemporary motivation research tends to be organized around three questions: (1). Can I do this task? (2). Do I want to do this task and why? (3). What do I have to do to succeed in this task?

**Can I do this task?**

As Broussard and Garrison note, those pursuing the first question developed a range of new theories regarding self-efficacy, attributions, and self-worth. Bandura(1982) defines perceived self-efficacy as judgments of how well one can execute courses of action required to deal with prospective situations. Eccles and Wigfield (2002) elaborate on Bandura's description, defining self-efficacy as an individual's confidence in his or her ability to organize and execute a given course of action to solve a problem or accomplish a task. According to Bandura's (1982) self-efficacy theory, efficacy is the major determinant of effort, persistence, and goal setting. Empirical research supports this notion, suggesting that individuals with higher self-efficacy tend to be more motivated and successful on a given task (Pintrich & DeGroot, 1990). Self-efficacy has also been associated with the use of cognitive strategies, and self-efficacy perceptions predict achievement over and above actual ability levels (Pintrich & DeGroot, 1990).

Another line of inquiry in the field of motivation explores the issue of locus of control. According to this theory, individuals should be more motivated to the extent that they feel they are in control of their own successes and failures (Eccles & Wigfield, 2002). In fact, in one formulation of control theory, autonomy is one of three basic psychological needs, along with competence and relatedness. Within this framework, individual differences in the extent to which these basic needs are fulfilled correspond to variation in levels of motivation Connell & Wellborn, 1991, as cited in (Eccles & Wigfield, 2002).

Finally, self-worth theory is somewhat related to both self-efficacy and locus of control. According to this theory, students need to believe they are competent in academic domains to feel they have self-worth in the school context Covington, 1992, as cited in (Eccles & Wigfield, 2002). This line of research suggests that students attempt to maximize their self-worth and will protect a sense of competence by making causal attributions that enhance their sense of competence and control.

**Do I want to do this task and why?**

A separate body of research within the study of motivation has focused on answering the question, Do I want to do this task and why? Under this category, Broussard and Garrison (2004) include expectancy-value theories, intrinsic motivation theories, and self-determination theory.

One strand of this literature focuses on the values individuals hold for participating in various types of activities (Eccles & Wigfield, 2002). Values are incentives or reasons for engaging in an activity. The value of a given task or activity has four components: attainment value, which refers to the personal value of doing well on a task; intrinsic value, which refers to subjective interest or enjoyment of performing a task; utility value, which refers to the extent to which task completion is perceived to facilitate current or future goals; and cost, which refers to the negative aspects of engaging in a given task, such as anxiety and fear of failure (Eccles & Wigfield, 2002; Stipek, Feiler, Daniels, & Milburn, 1996).

The notion of intrinsic motivation is closely related to intrinsic value. Intrinsic motivation refers to motivation that is animated by personal enjoyment, interest, or pleasure, and is usually contrasted with extrinsic motivation, which is manipulated by reinforcement contingencies (Guay, Chanal, Ratelle, Marsh, Larose and Boivin, 2010). Typically, manipulation of extrinsic motivation is effected by the provision of rewards, which can be either tangible (e.g., money, grades, privileges, etc.) or intangible (e.g., praise). However, extrinsic motivation can come about by other means. For example, self-determination theory distinguishes several different types of regulatory mechanisms that can act as reinforcement. External regulation corresponds to the lowest level of self-determination, where behaviour is motivated by a desire for reward or punishment avoidance. Introverted regulation occurs when behaviour is driven by internal pressures such as obligation or guilt. Under identified regulation, individuals identify with or find personally important the reasons for performing an activity. Finally, under integrated regulation, the regulator is actually consistent with an individual's other values and needs and becomes part of one's self-identity. This latter type of regulation is the closest to intrinsic motivation (Guay, Chanal, Ratelle, Marsh, Larose and Boivin, 2010). Educators typically consider intrinsic motivation to be more desirable than extrinsic motivation, and some research suggests that the learning outcomes of intrinsic motivation are better than those obtained under extrinsic motivation (Ryan, Connell, & Plant, 1990).

Closely related to values are interests, which refer to an interactive relation between an individual and certain aspects of his or her environment (Hidi & Harackiewicz, 2000).

**What do I have to do to succeed in this task?**

A third strand of contemporary motivation research has focused on the question, what do I have to do to succeed in this task? Broussard and Garrison (2004) argue that this strand of research led to the development of self-regulation and volition theories, which both share an attempt to connect motivation with cognition. For example, self-regulated learners have been shown to use a variety of strategies, have high self-efficacy, and set goals for themselves. Self-regulated learners also monitor their own activities, evaluate their performance, and experience reactions to evaluation outcomes. The valence of a person's reaction to evaluation depends on the way that successes and failures are framed, with positive reactions more likely to spur increased motivation than negative ones. Thus, self-regulation theory postulates that individuals can fortify their own motivation by engaging in a number of self-regulatory strategies, such as setting appropriate and achievable goals, applying learning strategies, and monitoring and evaluating progress toward goals (Schunk & Zimmerman, 2007).

Similarly, Linnenbrink and Pintrich (2002) offer a model of the relationship between motivation and cognition that incorporates students' prior achievement, social aspects of the learning setting, motivational variables (e.g., expectancies and values), and cognitive variables (background knowledge, learning strategies, metacognition, and self-regulation). This model depicts motivation as both affecting and being affected by cognition, and both of these are, in turn, affected by social context. The model also portrays cognition and motivation as affecting academic engagement and achievement.

Finally, Corno (1993) proposes volition theory, defining volition as strength of will, akin to conscientiousness, discipline, self-direction, resourcefulness, and striving. Corno argues that the effect of motivation on behaviour is mediated by volition. In other words, motivation may lead to a decision to act, but volition is what determines whether those decisions are implemented. Whereas motivation helps to determines goals, volition supports management and execution of those goals.

**IMs and Students' Self-Efficacy**

IMs may enhance students' self-efficacy and for that matter their performance if instructors carefully select relevant materials to meet learning needs of their students.

Miltiadou and Savenye (2003), citing Bandura (1986), describe self-efficacy as an individuals' confidence in their ability to control their thoughts, feelings, and actions, and therefore influence an outcome. They also note from studies conducted by Pintrich and De Groot (1990) that any improvement in student self-efficacy leads to increased use of cognitive and meta-cognitive strategies resulting in higher academic performance.

Sandler (1998) notes three aspects of self-efficacy:

(i). It represents a composite of all life's past successes and failures experienced by an individual;

(ii). Individuals will exhibit differences in their general self-efficacy expectations; and

(iii). In general, self-efficacy ought to affect an individual's mastery expectations in a new situation.

Several researchers (Miltiadou & Savenye, 2003; Schunk & Pajares, 2002; Bandura, 1997) have established that those learners exhibiting a strong sense of self-efficacy have a greater chance of succeeding in an academic environment in comparison with learners possessing a diminished sense of self-efficacy. Gagné and Driscoll (1988) also note the learners can develop convictions that certain behaviour will produce a particular kind of performance outcome. They may know what behaviour is expected to achieve a good grade in a course (outcome expectation), but believe they cannot successfully perform that behaviour (efficacy expectation).

Unfortunately, the cultivation of a strong sense of self-efficacy begins at a very early age and relies on numerous life experiences for development. Consequently, it is difficult for any individual instructor or instructional designer to significantly alter an already well developed sense of efficacy, particularly if past academic performance has not been generally positive. Schunk and Pajares (2002) suggest that one method instructional designers might use to enhance student self-efficacy is to set specific, short term learning goals, that are viewed as challenging yet attainable within the student's perceived abilities. They note that timely performance feedback, particularly feedback that highlights student progress in achieving their learning goals, serves to strengthen self-efficacy and sustain motivation.

Bandura (1994) posits that social persuasion can have a very positive effect on self-efficacy by enlisting the confidence necessary for learners to succeed and by providing the mechanisms that will permit them to master assigned activities. Persuasion, particularly from the instructor, can also sustain motivation toward completion of course activities and curtail self-doubts that learners might harbour regarding their ability to succeed with their studies.

**Identification, Selection and Estimation of Instructional Resources (Materials)**

The decision about which science curriculum materials to use is one of the most important professional judgments that educators make. The decisions teachers make about which modules or materials to use and in what order largely determine what and how students will be expected to learn. These decisions are far too important to be based on a cursory examination of superficial properties of curriculum materials. Such a critical decision must be sufficient to determine whether the materials will be able to help students learn the content or whether it is in line with the needs of the students.

The National Science Resources Centre (NSRC), National Science Resources Center (NSRC), 1997), National Science Foundation(NSF), 1997) and American Association for the Advancement of Science(AAAS), 1997) identify three sets of well-tested criteria that educators and teachers may use when selecting science teaching and learning materials. The first set concerns pedagogical appropriateness, which encompasses strategies for building conceptual understanding, teaching science as inquiry, and applying effective instructional strategies. The second set concerns science content; the third deals with the presentation and format of the written materials. The three sets of criteria are listed below.

**Criteria for Judging Pedagogical Appropriateness**

A. Addressing the Goals of Elementary Science Teaching:

I. Do the materials focus on concrete experiences with science phenomena?

II. Do the materials enable children to investigate important science concepts in depth over an extended period of time?

III. Do the curriculum materials contribute to the development of scientific reasoning and problem-solving skills?

IV. Do the materials stimulate students' interest and relate science learning to daily life?

V. Do the materials build conceptual understanding over several lessons through a logical sequence of related activities?

VI. Does the instructional sequence include opportunities to assess children's prior knowledge and experience?

B. Focusing on Inquiry and Activity as the Basis of Learning Experiences:

I. Does the material focus on student inquiry and engage students in the processes of science?

II. Does the material provide opportunities for students to gather and defend their own evidence and express their results in a variety of ways?

C. Using an Effective Instructional Approach:

I. Does the material include a balance of student-directed and teacher-facilitated activities as well as discussion?

II. Does the material incorporate effective strategies for the teacher and/or students to use in assessing student learning?

III. Does the teacher's guide suggest opportunities for integrating science with other areas of the curriculum?

IV. Do the students have opportunities to work collaboratively and alone?

**Criteria for Judging Science Content**

I. Is the science content current and accurately represented?

II. Does the content emphasize scientific inquiry?

III. Is the content of the science program consistent with the National Science Education Standards?

IV. Does the background material for teachers address the science content that is taught, as well as common misconceptions?

V. Is the treatment of content appropriate for the grade level?

VI. Is the content free of bias?

VII. Is the writing style for students and teachers interesting and engaging, and is scientific language used appropriately?

VIII. Is scientific vocabulary used to facilitate understanding rather than as an end in itself?

IX. Is science represented as an enterprise connected to society?

**Criteria for Judging Presentation and Format**

I. Are the print materials for students well-written, developmentally appropriate, and compelling in content?

II. Are the directions for implementing activities clear in both the teacher's guide and student materials?

III. Are the suggestions for instructional delivery in the teacher's guide adequate?

IV. Are the materials free of ethnic, cultural, racial, economic, age, and gender bias?

V. Are appropriate strategies provided to meet the special needs of diverse populations?

VI. Are lists of materials for each activity provided, as well as a complete set of materials and information about reasonably priced replacement materials?

VII. Are safety precautions included where needed?

VIII. Are instructions for using laboratory equipment and materials clear and adequate?

In summary, Teachers must be able to select which materials are necessary, appropriate and relevant for the curriculum content to be taught. This leads to selection or picking which of the types identified is/are appropriate and relevant for teaching and learning of the topic. Learner characteristics are quite important here. For instance the use of plastic apparatus instead of glassware at the primary school level. Also the materials selected must be gender friendly.

**Improvisation of IMs**

Instructional resources bring reality into the classroom thereby boosting the interest of students. For that reason, teachers must make sure IMs are always available for use in the classroom, even in the absence of the standardized ones, instructors must be ready to improvise. Most of the topics in Physics are highly abstract especially Electricity and Magnetism and almost impossible to teach without appropriate instructional materials. Hence instructional material improvisation is inevitable if Electricity and Magnetism must be taught in schools. Hence effective teaching of Electricity and Magnetism demands effective improvisation of diverse types of instructional material resources.

According to Ashley (2004) teachers should not use any excuse to resort to poor teaching, instead they should learn to improvise diverse instructional materials against all odds and impediments. Hornby (2015) defined impediment as obstruction, obstacle or hindrance that delays or stops progress of something, an art or an action. Impediment is therefore any force or phenomenon that lowers, reduces or puts to an end the expected pace of any event or activity. Impediment could equally be occasioned by prevailing situation circumstance, or even personal disposition and potentials which the actor or actors find themselves. For example, if a teacher has an inherently poor intellectual disposition, his resourcefulness and ability to improvise instructional material may be grossly hindered (Ogbu, 2016).

Eshiet (1996) defined improvisation as the sourcing, selection, deployment of relevant instructional elements of teaching/learning process in the absence or shortage of the accredited teaching/learning elements for a meaningful realization of specified educational goals and objectives. For an improvised material to be valid, the material should provide the desired results expected, improve the lesson effectiveness and reduce to minimum the risk associated with the usage of the equipment.

Akude (2010) and Balogun (1982) stated that improvisation is the act of using alternative materials and resources to facilitate instruction whenever there is shortage or total absence of original imported teaching aids. For technology teachers, improvisation directly means the construction of simple instructional materials, equipment and instruments critically needed to make teaching and learning processes easier and interesting, since in most cases the original prototypes and models for teaching may never be available. Improvisation is the actual representation of scientific concepts through the use of non-conventional local materials, the target being to achieve fully the instructional objectives.

Wikipedia (2014) defined improvisation as the process of making or doing something using whatever equipment or material resource that is presently available simply because the originally expected material resources are not available. Hornby (2015) in his own view defined improvisation as the act of making something or inventing it as one goes on, being guided only by imagination, instinct and guesswork rather than by a careful plan. These are two broad perspectives whereby improvisation can be viewed and defined. In the context of technology and vocational education teaching and learning processes, improvisation can be defined as the process of producing entirely new instructional material, tool, instrument or equipment from locally available materials and using same to teach the concerned technology content effectively. It may involve modifying the existing prototype or model to suit the topic at hand in a situation where there is no suitable teaching aid. In general, the newly produced instructional material or the modified prototype are called the improvisation of the usually imported original model or standard materials that are not available.

**Types of improvisation**

Improvisation can be of three types namely: improvisation by substitution; improvisation by modification; and improvisation by construction (Eminah, 2007). A brief description of each type is provided below:

I. Improvisation by substitution whereby an already existing local material is used in place of the equipment that is not available,

II. Improvisation by modification whereby an already existing model or material is improved upon to suit teaching and learning situation.

III. Improvisation by construction whereby the teacher constructs a new material to teach his lesson when the required original imported model of the equipment or materials are not available.

**Rationale for improvisation**

Teachers may discover that not all the available equipment and materials meet the needs and interest of their students. Improvising instructional materials is the logical action to take in the circumstance. This will enable teachers provide balanced activities to guarantee meaningful learning experiences for the students.

Improvisation also enables teachers to develop their creative potentials. The students/pupils also benefit especially where they are involved in the improvisation process.

Mboto, Ndem, and Utibeabasi (2011) observed that the use of improvised materials for teaching if carefully and properly planned enhances teaching and learning of science. It makes learning of science interesting, motivating, less boring and enjoyable to the students. They further stated that the success of the improvement the students taught with the improvised instructional materials is due to the fact that the improvised material provided the students with concrete experience which they need in order to develop their intellect.

The ability of the teacher to make use of local materials in place of standard ready-made materials makes lesson more effective and improved students' achievement (Oladejo, Olosunde, Ojebisi, & Isola, 2011).

**Why science teachers do not improvise materials for teaching/learning**

1. Lack of motivation in the form of allowance
2. Time consuming and demands sacrifice
3. Teacher's perception that time is wasted.
4. Lack of supervision by management
5. Lack of cooperation between school and parents
6. Lack of creativity and skills on the part of the teacher
7. Lack of financial support for buying materials needed for improvisation
8. Laziness on the part of the individual teacher concerned

According to Ogbu (2016), impediments to improvisation of IMs can be grouped into two:

1. Those emanating from teachers' characteristics;
2. And those caused by environmental and situational forces surrounding programme implementation.

**IMs and Experiential Learning**

David Kolb published his learning styles model in 1984 from which he developed his learning style inventory.

Kolb's experiential learning theory works on two levels: a four stage cycle of learning and four separate learning styles. Much of Kolb's theory is concerned with the learner's internal cognitive processes. Kolb states that learning involves the acquisition of abstract concepts that can be applied flexibly in a range of situations. In Kolb's theory, the impetus for the development of new concepts is provided by new experiences. Learning is the process whereby knowledge is created through the transformation of experience (Kolb, 1984).

**The Experiential Learning Cycle**

Kolb's experiential learning style theory is typically represented by a four stage learning cycle in which the learner 'touches all the bases':


**Figure 1: Kolb's experiential learning cycle**

1. **Concrete Experience** – (a new experience of situation is encountered, or a reinterpretation of existing experience).

2. **Reflective Observation** (of the new experience. Of particular importance are any inconsistencies between experience and understanding).
3. **Abstract Conceptualization** (Reflection gives rise to a new idea, or a modification of an existing abstract concept).
4. **Active Experimentation** (the learner applies them to the world around them to see what results).

Effective learning is seen when a person progresses through a cycle of four stages: of (1) having a concrete experience followed by (2) observation of and reflection on that experience which leads to (3) the formation of abstract concepts (analysis) and generalizations (conclusions) which are then (4) used to test hypothesis in future situations, resulting in new experiences.

Kolb (1974) views learning as an integrated process with each stage being mutually supportive of and feeding into the next. It is possible to enter the cycle at any stage and follow it through its logical sequence. However, effective learning only occurs when a learner is able to execute all four stages of the model. Therefore, no one stage of the cycle is an effective as a learning procedure on its own.

**Learning Styles**

Kolb's learning theory, Kolb and Fry (1974) sets out four distinct learning styles, which are based on a four-stage learning cycle (as shown in the Figure 2.1).

Kolb explains that different people naturally prefer a certain single different learning style. Various factors influence a person's preferred style. For example, social environment, educational experiences, or the basic cognitive structure of the individual.

Whatever influences the choice of style, the learning style preference itself is actually the product of two pairs of variables, or two separate 'choices' that we make, which Kolb presented as lines of axis, each with 'conflicting' modes at either end:

A typical presentation of Kolb's two continuums is that the east-west axis is called the **Processing Continuum** (how we approach a task), and the north-south axis is called the **Perception Continuum** (our emotional response, or how we think or feel about it).

Kolb believed that we cannot perform both variables on a single axis at the same time (e.g. think and feel). Our learning style is a product of these two choice decisions.

It's often easier to see the construction of Kolb's learning styles in terms of a two-by-two matrix. Each learning style represents a combination of two preferred styles. The diagram also highlights Kolb's terminology for the four learning styles; diverging, assimilating, converging and accommodating: Doing (Active Experimentation - AE) Watching (Reflective Observation - RO)

Feeling (Concrete Experience - CE) Thinking (Abstract Conceptualization - AC)

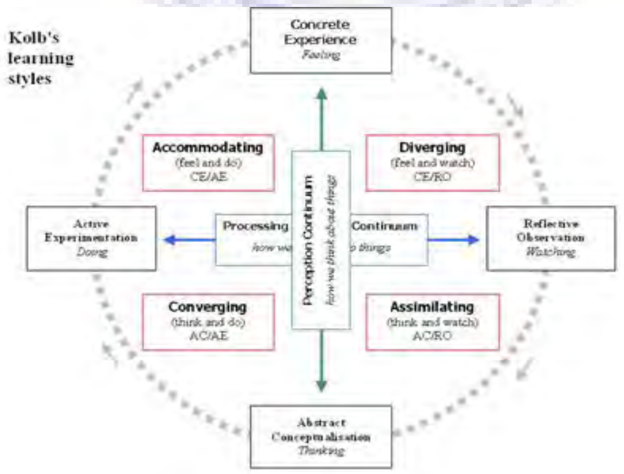


Figure 2: Kolb's learning styles **(1984). Source: www.businessballs.com**

**Learning Styles Descriptions**

Knowing a person's (and your own) learning style enables learning to be orientated according to the preferred method. That said, everyone responds to and needs the stimulus of all types of learning styles to one extent or another. It is a matter of using emphasis that fits best with the given situation and a person's learning style preferences.

Here are brief descriptions of the four Kolb learning styles:

**Diverging (feeling and watching - CE/RO)**

These people are able to look at things from different perspectives. They are sensitive. They prefer to watch rather than do, tending to gather information and use imagination to solve problems. They are best at viewing concrete situations at several different viewpoints.

Kolb called this style 'diverging' because these people perform better in situations that require ideas-generation, for example, brainstorming. People with a diverging learning style have broad cultural interests and like to gather information.

They are interested in people, tend to be imaginative and emotional, and tend to be strong in the arts. People with the diverging style prefer to work in groups, to listen with an open mind and to receive personal feedback.

**Assimilating (watching and thinking - AC/RO)**

The Assimilating learning preference is for a concise, logical approach. Ideas and concepts are more important than people. These people require good clear explanation rather than practical opportunity. They excel at understanding wide-ranging information and organizing it in a clear logical format.

People with an assimilating learning style are less focused on people and more interested in ideas and abstract concepts. People with this style are more attracted to logically sound theories than approaches based on practical value.

This learning style is important for effectiveness in information and science careers. In formal learning situations, people with this style prefer readings, lectures, exploring analytical models, and having time to think things through.

**Converging (doing and thinking - AC/AE)**

People with a converging learning style can solve problems and will use their learning to find solutions to practical issues. They prefer technical tasks, and are less concerned with people and interpersonal aspects.

People with a converging learning style are best at finding practical uses for ideas and theories. They can solve problems and make decisions by finding solutions to questions and problems.

People with a converging learning style are more attracted to technical tasks and problems than social or interpersonal issues. A converging learning style enables specialist and technology abilities. People with a converging style like to experiment with new ideas, to simulate, and to work with practical applications.

**Accommodating (doing and feeling - CE/AE)**

The Accommodating learning style is 'hands-on', and relies on intuition rather than logic. These people use other people's analysis, and prefer to take a practical, experiential approach. They are attracted to new challenges and experiences, and to carrying out plans.

They commonly act on 'gut' instinct rather than logical analysis. People with an accommodating learning style will tend to rely on others for information than carry out their own analysis. This learning style is prevalent within the general population.

**Educational Implications of Experiential Learning**

Both Kolb's (1984) learning stages and cycle could be used by teachers to critically evaluate the learning provision typically available to students, and to develop more appropriate learning opportunities.

Educators should ensure that activities are designed and carried out in ways that offer each learner the chance to engage in the manner that suits them best. Also, individuals can be helped to learn more effectively by the identification of their lesser preferred learning styles and the strengthening of these through the application of the experiential learning cycle.

Ideally, activities and material should be developed in ways that draw on abilities from each stage of the experiential learning cycle and take the students through the whole process in sequence (McLeod, 2013).

# CHAPTER THREE

# METHODOLOGY

## Overview

In this chapter is the description of research design, area of study, targeted population, sample and sampling techniques made. Also the data collection instruments, validity and reliability of data collection instruments, data analysis procedures and research ethical issues are also well described.

This study was aimed at investigating the effect of the use of instructional resources on the academic performance of students in Nkwanta Senior High School. It was a quasi-experimental study and the purpose was to see the relative effectiveness of independent variable, (instructional resources) on the academic achievement of students.

In order to sustain the validity of the study, it was necessary to look into the various designs usually adopted in experimental research.

## Research Design

The study adopted quasi experimental design with mixed approach that is, quantitative and qualitative approach, because the study include both statistical data and analytical or descriptive information. Denscombe (2007) argued that a mixed approach strategy is one that uses both qualitative and quantitative methods.

Campbell and Stanley (1963) define internal validity as the basic requirements for an experiment to be interpretable while external validity addresses the question of generalizability.

They identified eight factors which affect internal validity including:

1. History, the specific events occurring between the first and second measurements in addition to the experimental variables.
2. Maturation, processes within the participants as a function of the passage of time (not specific to particular events), e.g., growing older, hungrier, more tired, and so on.
3. Testing, the effects of taking a test upon the scores of a second testing.
4. Instrumentation, changes in calibration of a measurement tool or changes in the observers or scorers may produce changes in the obtained measurements.
5. Statistical regression, operating where groups have been selected on the basis of their extreme scores.
6. Selection, biases resulting from differential selection of respondents for the comparison groups.
7. Experimental mortality or differential loss of respondents from the comparison groups.
8. Selection-maturation interaction, design contamination, etc.

If these factors are not controlled in the design, they may produce poor results which confound the effects of the independent variable.

Campbell and Stanley (1963) again described four factors jeopardizing external validity or representativeness:

1. Reactive or interaction effect of testing, the pre-test sensitizes participants to aspects of the treatment and thus influences post-test scores.

2. Interaction effects of selection biases and the experimental variable.

3. Reactive effects of experimental arrangements, which would preclude generalization about the effect of the experimental variable upon persons being exposed to it in non-experimental settings.

4. Multiple-treatment interference, where effects of earlier treatments are not erasable.

With the above factors which affect the internal and external validity in mind, the researcher found the pre-test-post-test quasi experimental design to be most appropriate for this study. In this design, subjects are not randomly assigned to the research participants.

According to Gribbons and Herman (1997), quasi-experimental designs are commonly employed in the evaluation of educational programmes when random assignment is not possible or practical. Pre-test-post-test design was employed for the study. This design is one of the most effective in minimizing threat due to reactive effects of experimental arrangements. In other words, utilizing quasi-experimental designs minimizes threats to external validity as natural environments do not suffer the same problems of artificiality as compared to a true experimental design. Since in quasi-experiments, the participants are left in their natural environments, findings in one may be applied to other subjects and settings, allowing for some generalisations to be made about the population.

**Population**

Population refers to entire group of individuals, events or objects having common observable characteristics. A population refers to the entire spectrum of a system of interest (Panneerselvam, 2004). The population of this study comprised all students in the Senior High Schools in Nkwanta South District. The targeted population used for the study however, was all Form Three (3B) students of Nkwanta Senior High School studying science as an elective subject.

**Sample and Sampling Technique**

Mouton(1996) defines a sample as elements selected with the intention of finding out something about the total population from which they are taken. Considering factors such as time, finances and accessibility, it is however, practically impossible to access information from all the targeted population. Form Three (3B) Science class which consist of thirty-seven (37) boys and three (3) girls was selected for the study. The Form Three (B) science class of Nkwanta Senior High School was chosen for this study because the researcher happens to be a teacher to the school and also it is the class with many of its students having conceptual difficulties in Electricity and Magnetism and as a result affecting their performance in Physics. The researcher has been teaching Physics in this school for the past seven (7) years, with this experience coupled with terminal reports and WASSCE results aroused the researcher's interest to delve into this area of study. The researcher has also over the years observed that students of Nkwanta Senior High School show negative attitudes such as not attending classes, not paying attention to what is going on in class, not contributing enough during Physics lessons and low scores in Physics related concepts. Because of the negative attitudes such as laziness, lack of interest, truancy, lack of motivation exhibited by these students towards Physics lessons, the researcher deem it important to find out if the use of instructional resources will have any effect on their academic performance and also arouse their interest and motivate them to learn Physics.

The Form Three B science class, which is made up of forty students, thirty-seven (37) boys and three (3) girls, was selected on purpose and convenience. Purposive sampling is a form of non-probability sampling in which decisions concerning the individual to be included in the sample are taken by the researcher based on a variety of criteria which may include specialist knowledge of the research issue, or capacity and willingness to participate in the research (Benard, 2002; Lewis & Sheppard, 2000). Purposive sampling may have the advantage of eliminating those who are unsuitable for the study. The process of selecting sample could be less time consuming and also cost effective. However, there could be the disadvantage of the samples not being easily defensible as being a representative of population due to potential subjectivity of the researcher.

Convenience sampling on the other hand is also a type of non-probability sampling which includes the sample being drawn from that part of the population close to hand. Thus, a sample population is selected because it is readily available and convenient to the researcher. The choice of form three science students is due to the fact that it is easily accessible to the researcher and also one of the classes he teaches.

**Research Instruments**

Due to the objectives of the study, there was the need to gather data on students learning outcomes and attitudes towards Physics. The research instruments used consist of a pre-test and a post-test taken by the research participants in order to obtain data. The purpose of the tests was to measure the achievement of students constituting the sample for the study. The test items were based on some selected topics in Electricity and Magnetism and is treated during the study period. Among the topics treated are; the principles of the electric motor and generator, electromagnetic induction, ac theory, the principles of transformers, resistor in series and in parallel, the magnetic effect of currents and Flemings left and right hand rules.

Both the pre-test and the post-test items were based on these topics under Electricity and Magnetism which was treated during the study. Colleagues from the department and the head of the department reviewed the test items and approved of them. This was done to ensure that the test items were set at the appropriate levels of the sample and that the items had the desired content validity. The test items were made up of multiple-choice questions. These types of test item was chosen to reduce the effect of subjectivity in scoring. The test items were scrutinised by experts in Physics including my supervisor. They were pilot tested on behalf of the researcher by his colleagues in two other Senior High Schools outside the Nkwanta South District.

**Validity of the Instrument**

Validity in quantitative research determines whether the research truly measures what it was designated to measure or what it was set out to measure, how truthfully the research results are. In order to ensure that the test items for the study were valid it was given to a supervisor for a thorough examination to ensure that it measures the total content area (content validity) of the study. According to Merriam (1998), to ensure internal validity, three Physics experts were employed to study the test items and comment on it.

**Reliability of the Instrument**

Reliability refers to the extent to which research findings can be replicated. A reliability test was performed to ensure accurate measurement of the instrument. These tests were aimed at finding out the performance of students before and after the intervention.

Jonassen (2000) believes that once an instrument is valid, it is certainly reliable. To ensure the reliability of the instrument, a pilot testing was done on a similar pre-intervention test. This was done with form three (3) Physics students in Kadjebi Asato Senior High School and Oti Senior High School in the Volta Region who were not part of the sample for the study. The result from Physics students from Kadjebi Asato Senior High School was chosen and used in the reliability analysis because they are perceived to perform better in Physics as compare to the Oti Senior High students and that makes the instrument reliable for this study. The post-intervention test was not pilot tested since it is similar in structure with the pre-intervention test. Hence the corrections that were done on the pre-intervention test informed that of the post-intervention test. Data from the pilot test were statistically analysed to determine the reliability of the test instruments using Spearman-Brown prophecy formula since all items on both pre-intervention test and post-intervention test were dichotomously scored. The analysis yielded reliability co-efficient of 0.58 and 0.62 for the pre-intervention test and post-intervention test respectively as shown in Table 2.

**Table 2: The Reliability Co-efficient of the Research Instrument**

| Research Instrument | Number of Students | Reliability Co-efficient |
|---|---|---|
| Pre-Intervention test | 40 | 0.58 |
| Post-Intervention test | 40 | 0.62 |

According to Miles and Huberman(1994), if the measurement results are to be used for making a decision about a group or for research purposes or if an erroneous initial decision can be easily corrected, then the scores with the modest reliability co-efficient in the range of 0.50 to 0.60 may be accepted. From the above reliability co-efficient for the pre-intervention test and post-intervention test signifies that both test instruments are considerably reliable.

**Data Collection Procedure**

The data collection was divided into three stages: Pre- Intervention, Intervention and Post-Intervention stages.

**Pre-Intervention**

Impact assessment of instructional resources on academic outcomes is a ‘with and without’ situation. Before the use of instructional resources to teach, the researcher taught the form three (3B) science class of Nkwanta Senior High School some selected topics in Electricity and Magnetism without the use of instructional resources. Thus, the students were taught using traditional way of teaching. After four (4) weeks, a pre-test was conducted and marks of each sampled student were recorded against their serial numbers.

**Intervention**

The researchers arranged the three science students for another four (4) weeks instruction. This time round, the lesson was taught with PowerPoint presentation using projector together with other instructional materials such as science laboratory equipment, electromagnetic kit, computer simulations such as sun-flower which was supplied to most of the Senior High Schools in the country by Itec Ghana Limited. The sun-flower programme contains simulation on all the concepts in Physics, Chemistry and Biology. At the end of this interactive session in which the researcher used the various scientific models and both improvised and standardised instructional resources to teach the students, test items similar to the questions used in the pre-test were administered to the students as post-test.

**Intervention Activities**

In order to produce good results, the researcher selected instructional resource materials he deemed appropriate to design and implement an intervention that would help him meet the learning needs of the students. It is worth noting that only four (4) out of the selected topics treated under Electricity and Magnetism are discussed in details here. The intervention cannot cover all the individual topics in the SHS Physics syllabus using the instructional resources approach but the pedagogical techniques or skills employed were suitable for all the other topics, especially Electricity and Magnetism. The pre-test and the post-test questions were also based on all the selected topics treated on Electricity and Magnetism and not restricted only to those discuss here.

The samples were subjected to the same treatment for four weeks each. The samples were first taken through the traditional method of teaching of the concepts of Electromagnetic induction, construction of electric motor, the magnetic effect of electric current and the effective resistances of resistors connected in series and parallel among others. After using the traditional method of teaching for four weeks, a pre-intervention test was conducted to assess the performance of the students on the lesson taught. The pre-intervention test consisted of 20 multiple choice questions. The students' response was collected, marked and recorded.

The research sample was taught using laboratory equipment, computer simulations and electromagnetic kit for the next four weeks. The computer simulations was always first projected on a screen after which the various concepts of Electromagnetic induction, construction of electric motor, the magnetic effect of electric current and the effective resistances of resistors connected in series and parallel were taught using other required instructional materials through practical activities. Through these practical activities, learners were able to connect Physics to everyday life. The computer simulations projected also served as instructional guide for learners to carry out their practical activities. After the four weeks, a post-intervention test was conducted to assess the performance of the subjects on the lesson taught. The class test consisted of 20 multiple choice questions. The students' response was collected, marked and recorded.

**Week 1.**

**Activity 1: Electromagnetic Induction**

**Materials:** bars of magnets. Electric wires, electric bulb, rubber bands, insulating tape armature, steel yoke, split pins, knitting needles, rivets and a base. All from the electromagnetic kit

**Procedure:** The setup is as shown in Figure3. The Frame was rotated in a uniform magnetic field. The ends of the frame were supported by two rings which were connected to a small electric bulb. As the students rotate the frame, the bulb lights. This is because of the phenomena of electromagnetic induction. Electromagnetic induction is the phenomenon of production of potential difference across the ends of a conductor moving in a magnetic field.

This activity was also used to confirm Fleming's right hand rule as students track the directions of current, the magnetic field and the rotation of the frame using their right hand as shown in Figure4.

Fleming's right hand rule: The first finger points in the direction of the field, the thumb in the direction of the motion of the conductor and the second finger points in the direction of the induced current in the conductor.

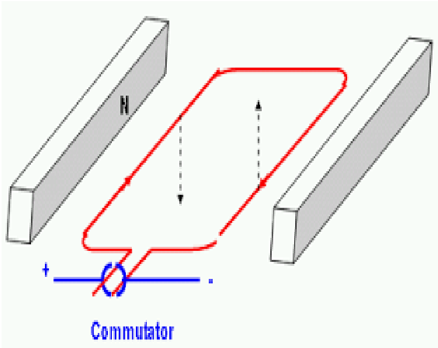


Figure 3: Electromagnetic induction

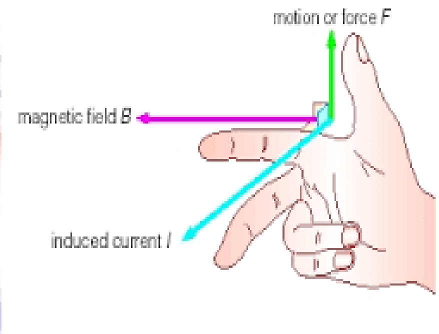


Figure 4: Fleming's right hand rule

**Week 2.**

**Activity 2: Construction of Electric Motor**

**Materials:** Electromagnetic kit, magnets, wires, rubber bands, insulating tape batteries, armature, steel yoke, split pins, knitting needles, rivets and a base.

**Procedure:** The setup for construction of electric motor is as shown in the diagrams. The wire was wound round a cuboid shaped plastic material with long nail/metal rod piers through its centre as the pivot of rotation to form the armature. When the wire brushes connected to a battery was brought in contact with the ends of the wounds on the opposite side of the nail/metal bar in a magnetic field, the coil with the cuboid started rotating. This activity was also used to confirm Fleming's left hand rule as the students use their left hands to trace the directions of the current, magnetic field and the force.

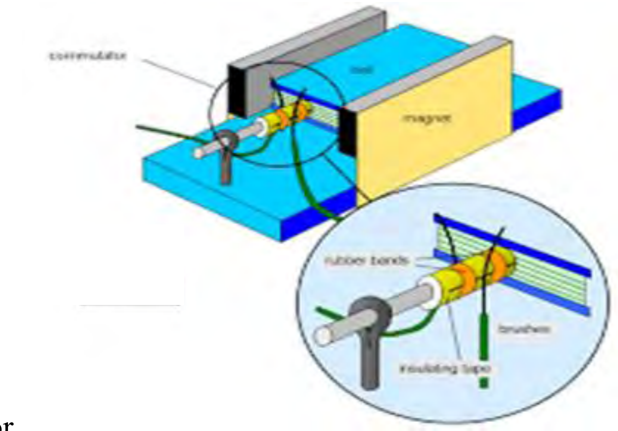

Figure 5: Electric Motor

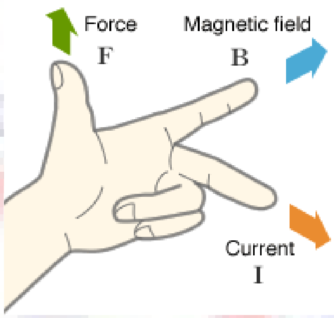


Figure 6: Fleming's left hand rule

**Week 3.**

**Activity 3: The Magnetic Effect of Electric Current**

**Materials used**: Iron nail, electric wire, batteries, paper clips.

**Procedure:** In this activity, the students were guided to verify the phenomenon of magnetic field being generated when current flows through a conductor using a simple circuit as shown in figure7. An electric wire was wound around an iron nail and the two together brought near a paper clip but there was no attraction. When the students connect a battery to the ends of the wire and the setup brought to the paper clips they were attracted by it. This proves that magnetic field is really generated when current passes through a conductor.

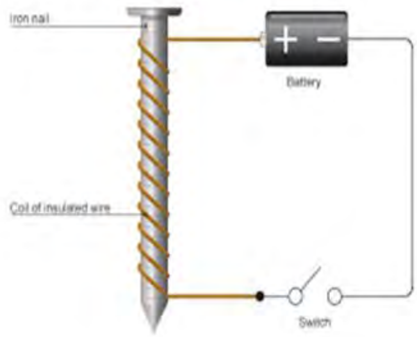


Figure 7: The Magnetic Effect of Electric Current

**Week 4.**

**Activity 4: The Effective Resistances of Resistors Connected in Series and in Parallel**

**Materials:** Resistors, electric wires, breadboard and digital multimeter.

**Procedure:** Students were guided to connect resistors in series and then in parallel on breadboard and in each case a digital multimeter was used to measure the effective resistances across the ends of the two connections as shown in the diagrams. The measured values were compared to the already calculated values.

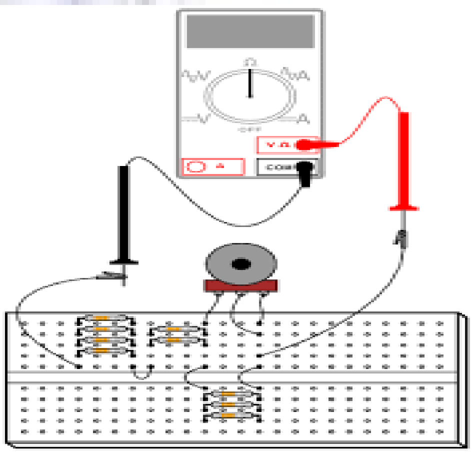

Figure 8: Components on a breadboard

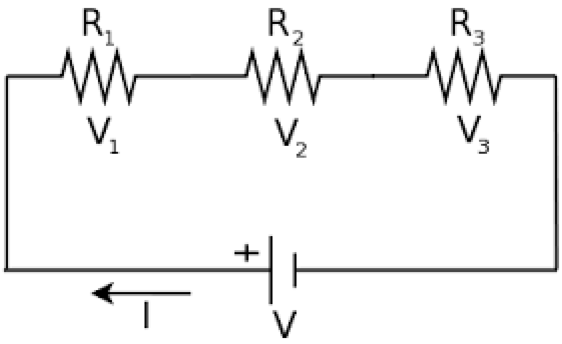


Figure 9: Resistors Connected in Series

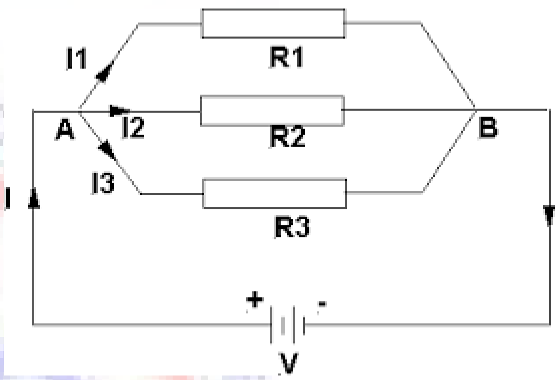


Figure 10: Resistors Connected in Parallel

**Summary.**

In summary the researcher collaborated the real experiments with simulations in real times of the experiments. Teaching and Learning in this way will complete the knowledge of the students and make lessons more attractive to motivate learners. The collaboration of computer simulations with didactical science activities will help learners in creative and critical thinking, acquire skills for processing and presentation of information, and also offers educators alternative suggestions for teaching / learning, and how issues concerning physical phenomena should be approached. .

**Post Intervention**

The post-intervention stage was intended to observe the difference that instructional resources have made on students' academic outcomes and learning motivations.

Observation techniques coupled with unstructured interview was conducted to gather the views of the students on their perception of the use of laboratory equipment, computer simulations and electromagnetic kit in teaching and learning of electricity and magnetism and traditional method of teaching.

This was done by observing the research participants' behaviour for a week after the post intervention in their natural environment during the subsequent lessons. This was done to seek how instructional resources have impacted on their learning motivations.

**Data Analysis**

The pre-test conducted after the pre-intervention was scored and scores were documented. The post-test scores were also documented.

To see the treatment effect, the mean scores were computed to determine the average achievement on the variable of the pre-test and post-test. In addition, the significance difference between the mean scores was tested at 0.05 level by applying t-test based on the pre-test and the post-test.

# CHAPTER FOUR

# DATA PRESENTATION, ANALYSIS AND DISCUSSION OF RESULTS

## Overview

This chapter deals with the presentation of the data collected and the analysis of the results. Percentages, frequencies, mean, standard deviation (Sd), t-value and probability (p-value) were employed to analyse the data collected. The data collected from pre-intervention test after the students have been taught through the traditional method was analysed. Also the data collected from post-intervention test after they have been taught using the instructional resources was also analysed. The discussions of the results is also considered in this chapter.

## Analysis of Data

The data collected from the students' pre-intervention and post-intervention test results were analysed based on the research questions for this study.

## Analysis with respect to Research Question One

**Research Question 1: How will the use of instructional materials influence the teaching and application of Electricity and Magnetism in Senior High Schools?**

This question sought to find out if there will be any effect on the students' academic performance/achievement in the selected topics in Electricity and Magnetism before the introduction of the intervention. Thus, during the traditional method of teaching. The following tables show the scores obtained when 20 multiple choice test items on selected topics in Electricity and Magnetism was administered after the topics were taught using the traditional method of teaching. The data also present the raw scores of the respondents, their corresponding percentile marks and grades based on WAEC and

GES standards. The frequency and percentile distribution of students' scores at pre-intervention test are presented. The total score was 20 marks with 40 respondents.

**Marks of Students at Pre-Intervention Test**

The Table 3 presents the scores of the samples and their corresponding converted percentile marks on WAEC and GES standards with its frequencies and percentages.

**Table 3: Frequency and Percentile Distribution of Students scores at Pre intervention test**

| Score | Percentile score | Frequency | Percentage frequency |
|---|---|---|---|
| 4 | 20 | 9 | 22.5 |
| 5 | 25 | 4 | 10 |
| 6 | 30 | 3 | 7.5 |
| 7 | 35 | 6 | 15 |
| 8 | 40 | 11 | 27.5 |
| 9 | 45 | 2 | 5 |
| 10 | 50 | 1 | 2.5 |
| 11 | 55 | 1 | 2.5 |
| 12 | 60 | 1 | 2.5 |
| 17 | 85 | 2 | 5 |
| **Total** | | **40** | **100** |

From Table 3 each raw score was giving a weight of 5% which indicates that a total score of 20 is a 100% on the percentile score. The raw scores obtained ranged from 4 to 17 which were converted from 20% to 85% on the percentile scale. Gravetter and Wallnau (2004) define a raw score as a single score that is derived from a test or an observation whilst cumulative percentages determine placement among a group of scores. Converting raw scores into cumulative percentages allow for meaningful comparisons. Table 3 therefore presents the percentile score of 20 which was obtained by 9 students representing 22.5% of the respondents. Also 2 students obtained the highest percentile score of 80 representing 5% of the sample. In table 3.the percentile score of 40 was recorded as the highest frequency mark for 11 students representing 27.5% of the sample obtained.

**Grades of the students after the Pre-Intervention Test**

Table 4 presents the pre-intervention test marks of the students during the traditional method of teaching based on the WAEC and GES grading system. This shows how the subject had performed on the WAEC and GES grading standard.

**Table 4: Grades the made students during the pre-intervention test**

| Expected performance | Grade | Remarks | Frequency | Percentages |
|---|---|---|---|---|
| 0–39 | F9 | Fail | 22 | 55 |
| 40–54 | D7–E8 | Pass | 14 | 35 |
| 55–69 | C4–C6 | Credit | 2 | 5 |
| 80–100 | A1 | Excellent | 2 | 5 |
| **Total** | | | **40** | **100** |

From Table 4, the best grade was A1 which had a frequency of 2 thus representing 5% followed by grade C4 to C6 with frequency of 2 representing 5% then grade D7 to E8 with frequency of 14 representing 35% and finally grade F9 representing 55% of the sample obtained. These data suggest the best grade obtained during the pre-intervention test was A1 and the least was F9 whiles the grade obtained by majority of the students (22 students) was F9 which represented 55%. The results showed that majority of the students had fail remark according to the WAEC and GES grading system. This implies that more than one-third of the samples fail because on the WAEC grading system F9 was rated as a very poor remark. In this study, the data collected on the pre-intervention test was in support of Clinton and Kohlmeyer (2005) study that showed no change in the students' results of the concept taught during the traditional method of instruction. Therefore in this study, students' results at pre-intervention test were compared to their usual performance before the intervention activities and the results showed that there was no significant change.

**Analysis with respect to Research Question Two**

**Research Question 2: To what extent will the use of instructional materials influence the academic performance of Nkwanta Senior High School students in Electricity and Magnetism?**

This question sought to find out if there will be any significant difference in the academic achievement of the Nkwanta Senior High School students due to the use of instructional materials in teaching Electricity and Magnetism. Tables 5, 6 and 7 show the scores obtained when 20 multiple choice test items on selected topics in Electricity and Magnetism was administered after the topics were taught using the laboratory equipment, computer simulations and electromagnetic kit. The data also presents the raw scores of the respondents, their corresponding percentile marks and grades based on WAEC and GES standards. The frequency and percentile distribution of students' scores at post-intervention test are presented. The total score was 20 marks with 40 respondents.

**Students Marks at Post-Intervention Test**

The Table 5 presents the scores of the samples and their corresponding converted percentile marks on WAEC and GES standards with its frequencies and percentages.

**Table 5: Frequency and Percentile Distribution of Students scores at Post-intervention test**

| Score | Percentile score | Frequency | Percentage frequency |
|---|---|---|---|
| 11 | 55 | 1 | 2.5 |
| 12 | 60 | 1 | 2.5 |
| 13 | 65 | 1 | 2.5 |
| 14 | 70 | 1 | 2.5 |
| 15 | 75 | 4 | 10 |
| 16 | 80 | 9 | 22.5 |
| 17 | 85 | 9 | 22.5 |
| 18 | 90 | 7 | 17.5 |
| 19 | 95 | 5 | 12.5 |
| 20 | 100 | 2 | 5 |
| **Total** | | **40** | **100** |

From table 5, each raw score was giving a weight of 5% which implies that a total score of 20 is a 100% on the percentile score. The raw scores obtained ranged from 11 to 20 which were converted from 55% to 100% on the percentile scale during the post-intervention test.

The Table 5 therefore presents the percentile score of 55 which was obtained by 1 student representing 2.5% of the respondents. Also 2 students obtained the highest percentile score of 100 representing 5% of the sample. In table 5 the percentile scores of 80 and 85 were recorded as the highest frequency mark for 9 students each representing 22.5% each of the sample obtained.

**Grades of the students after Post-Intervention Test**

The Table 6 presents the post-intervention test marks of the students during the computer animation method of teaching based on the WAEC and GES grading system. This showed how the subject had performed on the WAEC and GES grading standard.

**Table 6: Grades students made during the post-intervention test**

| Expected performance | Grade | Remarks | Frequency | Percentages |
|---|---|---|---|---|
| 55–69 | C4–C6 | Credit | 3 | 7.5 |
| 70–74 | B3 | Good | 1 | 2.5 |
| 75–79 | B2 | Very Good | 4 | 10 |
| 80–100 | A1 | Excellent | 32 | 80 |
| **Total** | | | **40** | **100** |

From Table 6 the best grade was A1 which had a frequency of 32 thus representing 80% followed by grade B2 with a frequency of 4 representing 10% then grade B3 with frequency of 1 representing 2.5% and finally grade C4 to C6 with frequency of 3 representing 7.5%. These data suggest the best grade obtained during the post-intervention test was A1 and the least was C4 to C6 whiles the grade obtained by majority of the students was A1 which represents 80% and the least was a B3. The results showed that majority of the students had excellent remark according to the WAEC and GES grading system. In this study, the data collected on the post-intervention test was in support ofCardoso, Cristiano andArent (2009) study which recommended the need for the development and implementation of new educational practices to make classrooms more interesting and interactive even in a lecture format and also increase the performance of students.

**Analysis using single paired sample t-test**

With the administration of the test items, the researcher was interested in finding out whether the use of laboratory equipment, computer simulations and electromagnetic kit in teaching electricity and magnetism had any effect on the performance of the students as against the traditional method of teaching. Therefore t-test analysis was performed on the mean scores for pre-intervention test and post-intervention test. This was done to determine whether significant difference exist between the mean scores.

**Table 7: t-test Analysis of Pre-intervention and Post-intervention test**

| Test | N | Mean | Sd | t-value | Mean difference | p-value |
|---|---|---|---|---|---|---|
| Pre-Intervention | 40 | 7.22 | 3.068 | -32.576 | 9.48 | 0.000 |
| Post-Intervention | 40 | 16.70 | 1.977 | | | |

***p<0.05, N-Number of Students**

Table 7 presents the mean score for pre-intervention test of students taught through the traditional method of teaching and the mean score for post-intervention test of students taught through the use of laboratory equipment, computer simulations and electromagnetic kit in teaching and learning of electricity and magnetism. It is observed that the mean score of the post-intervention test (Mean = 16.70, Sd = 1.977) is much higher than the mean score of the pre-intervention test (Mean = 7.22, Sd = 3.068). Also the total performance scores of the entire sample put together on the post-intervention test (668) was higher than the total scores at the pre-intervention test (289). This implies that there was an improvement in performance of 39.6% during the post-intervention test. A paired t-test conducted to evaluate whether a significant change occurred between the pre-intervention test and post-intervention test, results showed that the difference between the mean scores was significant at p-value of 0.000 which the significant was set at alpha (α) value of 0.05 hence there was a significant difference. The researcher therefore concludes with 95% confidence that the samples performed better at the post-intervention test. The researcher therefore had sufficient information to conclude that there was a significant difference between the use of laboratory equipment, computer simulations and electromagnetic kit in teaching electricity and magnetism and the traditional method of teaching. Difference in the mean values of the pre-intervention test (7.22) and post-intervention test (16.70) was 9.48 indicating that there was a moderate effect. This implies that there was an appreciable improvement in the post-intervention test as compared to the pre-intervention test.

**Analysis with respect to Research Question Three**

**Research Question 3:** How will the use of instructional resources motivate students to learn Electricity and Magnetism in Nkwanta Senior High School?

This question sought to establish the researcher's observation on how motivated the students have become after the intervention was used. It covers the perception of students about the use of instructional resources as compared to the traditional method of teaching. As indicated earlier, unstructured interview was conducted to gather the views of the students on their perception of the use of laboratory equipment, computer simulations and electromagnetic kit in teaching and learning of Electricity and Magnetism and traditional method of teaching. The questions covered the assimilation of the concept and their preference in terms of the teaching strategies they were exposed to.

**Assimilation of concept and preference with the use of laboratory equipment, computer simulations and electromagnetic kit in teaching and learning**

- Majority of the samples said they perceived the laboratory equipment, computer simulations and electromagnetic kit in teaching and learning of Electricity and Magnetism to be illustrative, quick and practical as it relates familiar objects and learners' environment to abstract concepts.
- Out of the total sample, majority of the sample also said that the use of instructional resources allowed them with different learning skills to communicate with the lesson at their own best ways.
- The entire sample said that the instructional resources guided them to understand better the concepts in Electricity and Magnetism. The students said that when the traditional method was employed there were not such clarity and understanding of some of the concepts.

**Attitude of students towards Physics lessons**

The researcher studied the attitude of the students for one week and observed that most of the students' attitudes towards physics has changed. The researcher observed that:

- The students have become more curious, and were always ready to ask questions both during classes and outside the classroom settings.
- They started building electric motors using local materials. For that reason, the researcher can then conclude that the use of instructional resources arouses students' interest and therefore motivate them to learn. This implies that the teaching of physics without the use of instructional materials may certainly result in poor academic performance. Students get motivated when they are actively involved in the teaching learning process and this will minimize teaching of Physics in abstraction

**Assimilation**

The students said they absorbed much during the use of instructional resources in teaching than the traditional method of teaching since the instructional materials aided them to understand better the concepts in Electricity and Magnetism. They said the use of instructional materials helped them built up a mental picture on their brains on the concepts taught as compared to the traditional method of teaching. Therefore the samples found it interesting and thus motivated them to learn.

**Preference**

The students said they preferred the use of instructional materials method of teaching since they could remember what was taught and could narrate enough of what they observed and viewed than that of the traditional method.

**Discussions of results**

The findings of this study revealed that collaboration of computer simulations with didactical science activities will help learners in creative and critical thinking, acquire skills for processing and presentation of information, and also offers educators alternative suggestions for teaching / learning, and how issues concerning physical phenomena should be approached. Teaching and Learning in this way will complete the knowledge of the students and make lessons more attractive to motivate learners. Which is in in line with the research findings of Fadeiye (2005) who posits that instructional materials are essential and significant tools needed for teaching and learning of school subjects to promote teachers' efficiency and improve students' performance. They make learning more interesting, practical, realistic and appealing. They also enable both the teachers and students to participate actively and effectively in lesson sessions. They give room for acquisition of skills and knowledge and development of self- confidence and self- actualization

The findings also revealed that the mean score of the post-intervention test (Mean = 16.70, Sd = 1.977) was much higher than the mean score of the pre-intervention test (Mean = 7.22, Sd = 3.068). Also the total performance scores of the entire sample put together on the post-intervention test (668) was higher than the total scores at the pre-intervention test (289). This implies that there was an improvement in performance of 39.6% during the post-intervention test. A paired t-test conducted to evaluate whether a significant change occurred between the pre-intervention test and post-intervention test results shows that the difference between the mean scores was significant at p-value of 0.000 in which the significant was set at alpha (α) value of 0.05, hence there was a significant difference. Difference in the mean values of the pre-intervention test (7.22) and post-intervention test (16.70) was 9.48 indicating that there was a reasonable effect. This implies that there was an appreciable improvement in the post-intervention test as compared to the pre-intervention test. This finding is also in line with findings of Oladejo, Olosunde, Ojebisi, & Isola (2011) who also asserted that there is a significant difference in the academic performance of students taught Physics using standard instructional materials, those taught with improvised instructional material and those in the conventional instruction. Where those taught using standard instructional materials performed better than those taught using conventional instruction.

Instructional materials help teachers to teach conveniently and the learners to learn easily without any problem and they have direct contact with all sense organs (Olumorin, Yusuf, Ajidagba, & Jekayinfa, 2010). Effective teaching and learning requires a teacher to teach the students with instructional materials and use practical activities to make learning more vivid, logical, realistic and pragmatic (Akinleye, 2010). It has been established by Olayinka (2016) that students taught with instructional materials have excellent achievement scores compared with those taught without any material. She further affirmed that importance of instructional materials in the development of learners' intellectual abilities and attainment of teaching/learning objectives cannot be over emphasized. There is statistical significant difference in the academic performance of students taught with instructional materials than those not taught with them (Ifeoma, 2013).

In addition, this study revealed that the use of instructional resource such as audios and videos make abstract concepts real to students since they will help them to observe, feel, practice and draw better conclusions. Instructional materials also help learners connect teaching and learning to everyday life since teaching and learning materials enhances students' curiosity and interest. Thus, they contribute to students' systematic knowledge and maturity, thereby motivating them to learn. This also affirms the research findings of Likoko, Mutsotso, and Nasongo (2013) in the study on adequacy of instructional materials and physical facilities and their effect on quality of teacher preparation in colleges in Bungoma county and a study done by Mbaria (2006) on the relationship between learning resources and performance in secondary schools in

Ndaragwa district. All the above studies indicate that TLR help improve access and educational outcomes since students are less likely to be absent from schools that provide interesting, meaningful and relevant experiences to them. These resources should be provided in quality and quantity in schools for effective teaching-learning process. Several studies have been conducted on the impact of instructional materials on education.

# CHAPTER FIVE

# SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

## Overview

This chapter gives the summary of the main findings of the research and conclusion of the study. It further continues with the limitations of the study and some recommendations in relation to the findings also suggestion for further studies is made here.

## Summary

This study was designed to investigate the effect of instructional resources in teaching and learning of physics in Nkwanta Senior High School as an auxiliary strategy on the academic performance of students.

The main objective of the study was to find out; the relative effect of instructional resources as supplementary strategy on students' academic performance in Electricity and Magnetism, if there will be any difference in the academic performance of Nkwanta Senior High schools students in Electricity and Magnetism due to the use of instructional materials and the effect of instructional materials on students' motivation to learn physics, specifically Electricity and Magnetism.

In order to obtain data for analysis, the scores of the pre-test and post-test were documented. Having obtained the scores, mean scores were computed to determine the higher average achievement on the variable of the pre-test and post-test. In addition the significance of difference between the mean scores was tested at 0.05 level by applying t-test based on the pre-test and the post-test.

The analysis of data showed that the students taught through the use of instructional resources performed significantly better than those taught through the traditional way of teaching. Thus, performance in Physics and any other subject at the Senior High School Level will be very much depended on the extensive use of instructional resources to enhance the understanding of students in most of the concepts and thereby improving their academic achievement.

It was also observed that the mean score of the post-intervention test (Mean = 16.70, Sd = 1.977) was much higher than the mean score of the pre-intervention test (Mean = 7.22, Sd = 3.068). Also the total performance scores of the entire sample put together on the post-intervention test (668) was higher than the total scores at the pre-intervention test (289). This implies that there was an improvement in performance of 39.6% during the post-intervention test. A paired t-test conducted to evaluate whether a significant change occurred between the pre-intervention test and post-intervention test results shows that the difference between the mean scores was significant at p-value of 0.000 in which the significant was set at alpha (α) value of 0.05, hence there was a significant difference. The researcher therefore concludes with 95% confidence that the samples performed better at the post-intervention test. The researcher therefore had sufficient information to conclude that there was a significant difference between the use of laboratory equipment, computer simulations and electromagnetic kit in teaching electricity and magnetism and the traditional method of teaching. Difference in the mean values of the pre-intervention test (7.22) and post-intervention test (16.70) was 9.48 indicating that there was a reasonable effect. This implies that there was an appreciable improvement in the post-intervention test as compared to the pre-intervention test.

Most of the students also admitted they were highly motivated with the usage of the instructional resources in teaching and learning which was in line with the observation the researcher made when he studied the students' attitude for a week after the intervention.

The overall objective of teaching is to transfer knowledge to learners for them to understand and apply the knowledge being transmitted in solving problems. Teachers will agreed that they feel satisfied when they realise that the knowledge they transfer to students helped them to perform better in examinations and class exercise since it is one of the ways by which the quality of their services is assessed. Thus instructional resources would help them deliver their lesson successfully to the understanding of students which would consequently result in good performance in examinations and tests.

**CONCLUSION**

In conclusion, instructional resources are very powerful tools in Physics education, if achievement or performance is an objective. The use of instructional resources in instructional activities such as science laboratory experiments, computer models and simulations and power-point presentations makes lessons more interactive thereby making leaners more active than being passive during lessons.

In addition, the use of instructional resources make abstract concepts real to students since they will help them to observe, feel, practice and draw better conclusions. Instructional materials also help learners connect teaching and learning to everyday life since teaching and learning materials enhances students' curiosity and interest. Thus, they contribute to students' systematic knowledge and maturity.

Also collaboration of computer simulations with didactical science activities will help learners in creative and critical thinking, acquire skills for processing and presentation of information, and also offers educators alternative suggestions for teaching / learning, and how issues concerning physical phenomena should be approached. Teaching and Learning in this way will complete the knowledge of the students and make lessons more attractive to motivate learners.

**Limitations**

Ideally the researcher should have targeted a large number of Senior High Schools (SHS) in this study. However, due to proximity, accessibility, financial constraints and limited time the study concentrated on the Form Three (3B) Science Students at Nkwanta Senior High School.

In researches of this nature, where direct contact with the respondents is made, there is bound to be psychological and emotional imbalances which can make the respondents artificial and would not reflect normal classroom situations.

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**Recommendations**

Based on the findings of this research, the following recommendations are put forward;

- Well planned and regular meaningful in-service training, workshops and seminars on improvisation technique for Science teachers should be organized by the district to orient teachers to improvise alternative instructional resources and the right ways to use them during lessons. This will encourage appropriate usage to achieve the lesson objectives and encourage the students to use them as learning resources.
- Ministry of Education and Ghana Education Service should ensure frequent supply of instructional resources for use by teachers for effective teaching and learning. Such resources could include locally produced materials produced by teachers and resource experts for better lesson delivery.
- Ministry of Education and Ghana Education Service should provide funds to support local production of instructional materials by the teachers and encourage more teachers to produce and use them
- Finally, teachers and parents can also be a major contributing factor to the academic achievement of their wards. Thus, when teachers or instructors are able to select instructional materials to suit the age, cognitive development level and learning needs of their students, they become more proactive since all their senses will be activated. This coupled with parental motivation will increase students' self-efficacy and keep them in school all the time.

**Suggestion for further studies**

A further study on the impact of the schools' environment and buildings on the students' academic achievement and motivation is recommended in the Nkwanta South District.

## REFERENCES

Abdullahi, A. (1982). *Science Teaching in Nigeria.* Ilorin: Atoto Press.

Abdu-Raheem, B. O. (2011). Availability, adequacy and utilization of social studies instructional materials in Ekiti State secondary schools. *Journal of Current Discourse and Research, 1*(3), 242-255.

Abrahams, I., & Millar, R. (2008). Does practical work really motivate? A study of the effective value of practical work in secondary school science. *International Journal of Science Education, 30*(14), 1945-1969.

Abrams, E. (1998). Talking and doing science: Important elements in a tesching for understanding approach. In J. J. Mintzes, J. H. Wandersee, & J. D. (Eds), *Teaching science for understanding* (pp. 308-322). San Diego, CA: Academic Press.

Adebanjo, A. A. (2007). Effect of Instructional Media on the Learning of Computer in JSS. *African jounal of Educational Research, 1*(2), 71-75.

Adeogun, A. (2001). The principal and the financial management of public secondary schools in Osun State. *Journal of Educational System and Development, 5*(1), 1 - 10.

Agina-Obu, T. (2005). *The Relevance of Instructional Materials in Teaching and Learning in Robert-Okah.* (K. I & Uzoeshi, Ed.) Port Harcourt: Harey Publication.

Akinleye, G. A. (2010). Enhancing the quality of life in this complicated but dynamic world University of Ado-Ekiti, April 6. *25th inaugural lecture*.

Akude, I. (2010). *New technologies and innovative techniques in education.* Owerri: Bomaway Press.

Alsop, S., & Hicks, K. (2001). *Teaching Science:A Handbook for Primary and Secondary School teaching.* Glasgow: Bell & Bain Ltd.

American Association for the Advancement of Science. (1997). *The Project 2061 Curriculum-Analysis Procedure.*

Ashley, S. (2004). *Electrical installation and Maintenance Technology.* Enugu: Kingsway Publishers Ltd.

Balogun, T. (1982). Improvisation of school equipment. *Journal of Science Teachers Association, 2*(2), 247-259.

Balogun, T. (2002). Interest in science Technology Education in Nigeria. *Journal of Teachers Association of Nigeria, 23*(1 & 2), 92-99.

Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist, 37*(2), 122–147.

Bandura, A. (1994). Self-efficacy. In V. Ramachaudran, *Encyclopaedia of human behavior* (Vol. 4, pp. 71-81). New York: Academic Press Inc.

Bandura, A. (1996). Social cognitive theory of human development. In T. Husen, & T. N. Postlethwaite, *International Encyclopedia of Education* (2nd ed., pp. 5513-5518). Oxford: Pergamon Press.

Bandura, A. (1997). *Self-efficacy: The exercise of control.* New York: W.H. Freeman and Company.

Barry, N. H. (2007). Motivating the reluctant student. *American Music Teacher, 56*(5), 23-27.

Benard, H. R. (2002). *Research Methods in Anthropology: Qualitative and Quantitative Methods* (3rd ed.). California: Alta Mira Press.

Bennett, J. (2005). *Teaching and learning science: A guide to recent researc and its application.* London: Continuum.

Bolick, C. S., Berson, M., Coutts, C., & Heinecke, W. (2003). Technology applications in social studies teacher education: A survey of social studies methods faculty. *Contemporary Issues in Technology and Teacher Education, 3*(3). Retrieved may 19, 2016, from http://www.citejournal.org/vol3/iss3/socialstudies/article1.cfm

Borg, W., & Gall, M. (1996). *Educational research.* New York: Longman.

Bridgeland, J. M., DiIulio, J. J., & Morison, K. B. (2006). *The silent epidemic: Perspectives of high school dropouts.* Civic Enterprises, LLC: Washington, D.C.

Broussard, S. C., & Garrison, M. E. (2004). The relationship between classroom motivation and academic achievement in elementary school-aged children. *Family and Consumer Sciences Research Journal, 33*(2), 106–120.

Campbell, D., & Stanley, J. (1963). *Experimental and quasi-experimental designs for research.* Chicago, IL: Rand-McNally.

Cardoso, D. C., Cristiano, M. P., & Arent, C. O. (2009). Development of new didactic materials for teaching science and biology: The importance of new educational practices. *Journal of Biological Science, 9*(1), 1-5.

Center on Education Policy (CEP ). (2012). *Student Motivation—An Overlooked Piece of School Reform.* Washington, D.C. ,Pennsylvania Avenue NW: The George Washington University. Retrieved from www.cep-dc.org

Changeiywo, J. (2000). *Students Image of Science in Kenya: A Comparison by Gender difference of Schooling and Regional Disparities.* Nairobi: Unpublished PhD Thesis, Egerton University.

Clinton, B. D., & Kohlmeyer, J. M. (2005). he effects of group quizzes on performance and motivation to learn: Two experiments in cooperative learning. *Journal of Accounting Education, 23*(2), 96-116.

Corno, L. (1993). The best-laid plans: Modern conceptions of volition and educational research. *Educational Researcher, 22*(2), 14–22.

Deci, E. L., Koestner, R., & & Ryan, R. M. (1999). A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation. *Psychological Bulletin, 125[*(6), 627–668.

Denscombe, M. (2007). *The good Research guide for small-scale social research projects.* (3rd, Ed.) London: Open University Press.

Denscombe, M. (2007). *The good Research guide for small-scale social research projects* (3rd ed.). London: Open University Press.

Dweck, C. S. (2010). Mindsets and equitable education. *Principal Leadership, 10*(5), 26-29.

Eccles, J. S., & Wigfield, A. (2002). Motivational beliefs, values, and goals. *Annual Review of Psychology, 53*, 109–132.

Emily, R. (2011). *Motivation.* Pearson's publications. Retrieved November 15, 2016, from http://www.pearsonassessments.com/research

Eminah, J. K. (2007). Types and Rationale for Improvisation. *UMYU Journal of Educational Research, 1*(1), 138-141.

Eshiet, I. T. (1996). *Improvisation in Science Teaching; Philosophy and Practice.* Abak: Belpot (Nig.) Company.

Fadeiye, J. (2005). *A social studies textbook for colleges and universities.* Ibadan: Akin Johnson Press and Publishers.

Franzer, B.J, P.A.O., Okebukola, O.J., & Jegede. (1992). Assessment of the learning environment of Nigerian science laboratory classes. *J. Sci. Teacher Assoc. Nig, 27*.

Gagné, R., & Driscoll, M. (1988). *Essentials of learning for instruction* (2nd ed.). New Jersey: Prentice Hall.

Gottfried, A. E. (1985). Academic intrinsic motivation in elementary and junior high school students. *Journal of Educational Psychology, 77*(6), 631-345.

Gottfried, A. E. (1990). Academic intrinsic motivation in young elementary school children. *Journal of Educational Psychology, 82*(3), 525–538.

Gottfried, A. E. (2009). Commentary: The role of environment in contextual and social influences on motivation: Generalities, specificities and causality. In K. R. Wentzel, & A. Wigfield, *Handbook of motivation at school* (pp. 462-475). New York: Routledge.

Gravetter, F. J., & Wallnau, L. B. (2004). *Statistics for the Social Sciences.* Belmont, CA: Wadsworth.

Gribbons, B., & Herman, J. (1997). True and quasi-experimental designs. *Practical Assessment, Research & Evaluation, 5*(14). Retrieved September 20, 2016, from http://PAREonline.net/getvn.asp?v=5&n=14

Guay, F., Chanal, J., Ratelle, C. F., Marsh, H. W., Larose, S., & Boivin, M. (2010). Intrinsic, identified, and controlled types of motivation for school subjects in young elementary school children. *British Journal of Educational Psychology, 80*(4), 711–735.

Hidi, S., & Harackiewicz, J. M. (2000). Motivating the academically unmotivated: A critical issue for the 21st century. *Review of Educational Research, 70*(2), 151–179.

Ho, F. F., & Boo, H. K. (2007). Cooperative learning: Exploring its effectiveness in the Physics classroom. *Asia Pacific Forum on Science Learning and Teaching, 8*(2), 14-19. Retrieved from http//dx.doi.org/ied.edu.hk/apfslt

Hornby, A. S. (2015). *Oxford Advanced learners dictionary of current English* (8th New International Students edition ed.). Oxford: Oxford Press.

Ifeoma, M. M. (2013). Use of instructional materials and educational performance of students in Integrated Science. *Journal of Research and Method in Education, 3*(2), 7-11.

Isola, O. (2010). *Effects of Standardized and Improvised Instructional Materials.* Ibadan: M. Ed Thesis, University of Ibadan.

Isola, O. M. (2010). *Effects of Standardized and Improvised Instructional Materials.* Ibadan: M. Ed Thesis, University of Ibadan.

Jimoh, M. E. (2009). The use of instructional materials in teaching Social Studies at the secondary schools of Kabba Bunu Local Government area of Kogi State. Retrieved October 16, 2016, from http://www.docstoc.com

Jonassen, D. H. (2000). *Computers as mind tools for schools: Engaging critical thinking* (2nd ed.). Upper Saddle River, NJ: Prentice-Hall.

Joyce, B., Weil, M., & Calhoun, E. (2000). *Models of teaching.* Boston: Allyn and Bacon.

Joyce, L. (2001). *School, family, and community partnerships: Preparing educators and improving schools.* Boulder, CO: Westview Press.

Judy, C. (2001). Pervasive negative effects of rewards on intrinsic motivation:The myth continues. *The Behaviour Analyst, 24*, 1-44.

Jurisevic, I., Glazar, S. A., Pucka, C. R., & Devetak, I. (2008). Intrinsic Motivation of Preservice Teachers for Learning Chemistry in Relation to their Academic Achievement. *International Journal of Science Education, 30*, 87-107.

Klassen, S. (2009). Identifying and Addressing Pupil Dificulties with the Millikan Oil Drop Experiment. *Science and Education, 18*, 593-607.

Kolb, A. D. (1984). *Experiential learning: Experience as the source of learning and development* (Vol. 1). Englewood Cliffs, NJ: Prentice-Hall.

Kolb, D. A., & Fry, R. E. (1974). *Toward an applied theory of experiential learning. MIT Alfred P. Sloan School of Management.*

Krajcik, J., Reiser, B., Moje, J. E., & Marx, R. (2003). Design Strategies for Developing Science Instructional Materials., (p. 2003 Annual Meeting of the National Association of Research in Science Teaching). Philadelphia, PA. Retrieved from http://www.umich.edu/~hiceweb/iqwst/Papers/reiser_krajcik_NARST03.pdf

Larson, T. D. (2001). *comparison of fifth grade children receiving both traditional and technology based means of instruction in Social Studies.* Johnson Bible College Knoxville, USA: Unpublished master dissertation.

Lewis, J., & Sheppard, S. R. (2000). Culture and communication: Can landscape visualization improve forest management consultation with indigenous communities? *Landscape and Urban Planning, 77*, 291-313.

Likoko, S., Mutsotso, S., & Nasongo, J. (2013). Adequacy of instructional materials and physical facilities and their effect on quality of teacher preparation in colleges in Bungoma county. *International journal of science and research (IJSR).*

Linnenbrink, E. A., & Pintrich, P. R. (2002). Motivation as an enabler for academic success. *School Psychology Review, 31*(3), 313–327.

Lyons, A. (2012). *Workers of tomorrow, Education in progress,Ministry of Education and Scientific Research.* Port Fortis: Fiji.

Mba, T. N. (2004). *Adult education and development.* Port Harcourt: Pearl Publisher.

Mbaria, F. (2006). *Relationship between learning resources and performance in secondary schools in Ndaragwa district.* University of Nairobi, Nairobi: Unpublished PGDE Project.

Mboto, F. A., Ndem, N., & Utibeabasi, S. (2011, January). Effects of Improvised Materials on Students' Achievement. *An International Multi-Disciplinary Journal, Ethiopia, 5*(1), 342-353.

McLeod, S. A. (2013). Kolb - Learning Styles. Retrieved november 15, 2016, from www.simplypsychology.org/learning-kolb.html

Merriam, S. (1998). *Qualitative research and case study applications in education.* San Francisco: Jossey-Bass.

Miles, M. B., & Huberman, M. (1994). *Qualitative Data Analysis: A Source Book of New Methods.* Bervely Hills, CA: Sage Publications.

Miltiadou, M., & Savenye, W. (2003). Applying social cognitive constructs of motivation to enhance student success in online distance education. *Educational Technology Review, 11*(1). Retrieved october 19, 2016, from http://www.aace.org/pubs/etr/issue4/miltiadou.cfm

Minishi, O., Muni, E., Okumu, O., P., M., Mwangasha, G., Omolo, H., & & Munyeke, F. (2004). *Secondary Physics form one* (3rd ed.). Nairobi: Kenya Literature Bureau.

Mouton, J. (1996). *Uderstanding Social Research.* Pretoria: J.I.Van Schaik.

Murray, A. (2011). Montessori elementary philosophy reflects current motivation theories. *Montessori Life, 23*(1), 22-33.

National Research Council ( NRC ). (2004). *Engaging schools: Fostering high school students' motivation to learn.* Washington, DC: Author. Retrieved from http://books.nap.edu/openbook.php?record_id=10421&page=27

National Research Council. (1996). *National Science Education Standards.* Washington, D.C.: National Academy Press.

National Science Foundation. (1997). *Instructional Materials for Middle School Science.* NSF Publication.

National Science Resources Center. (1997). *Criteria for Selecting Inquiry-Centered Science Curriculum Materials.* Washington, DC: National Academy Press.

NTI. (2007). *Manual for the Re-Training of Primary School Teachers. Basic Science and Technology.* Kaduna: National Teachers Institute.

Nwosu, E. N. (2010). Utilization of information and communication technology (ICT) as a tool and strategies for improving teacher professional development for effective service delivery. *International Journal of Educational Resources, 2*(11), 86-95.

Ogbu, J. E. (2016, February). Impediments to Effective Improvisation of Instructional Materials for Teaching Electrical Installation Works in Ebonyi State Technical Colleges. *British Journal of Education, 4*(2), 51-60.

Ogunleye, A. O. (2000). Towards the optimal utilization and management of resources for effective teaching and learning of Physics in schools. *Proceedings of the 41st annual conference of the Science Teachers Association of Nigeria*, (pp. 215-220).

Okobia, E. O. (2011). Availability and Teachers' Use of Instructional Materials and Resources in the Implementation of Social Studies in Junior Secondary Schools in Edo State. *Review of European Studies, 3*(2), 90-111.

Oladejo, A., Olosunde, R., O., Ojebisi, & Isola, M. O. (2011). Instructional materials and students, academic achievemens in Physics. Some policy inplication. *European Journal of Humanities and Social Sciences, 1*(2), 112-126.

Olayinka, A. B. (2016). Effects of instructional materials on secondary schools students' academic achievement in social studies in Ekiti state, Nigeria. *World Journal of Education, 1*(6), 3239.

Olumorin, C. O., Yusuf, A., Ajidagba, U. A., & Jekayinfa, A. A. (2010). Development of Instructional materials from local resources for art-based courses. *Asian Journal of Information Technology, 9*(2), 107-110.

Oluwagbohunmi, M. F., & Abdu-Raheem, B. O. (2014). Sandwich undergraduates' problem of improvisation of instructional materials in social studies: The case of Ekiti State University. *Journal of International Academic Research for Multidisciplinary, 1*(12), 824-831.

Panneerselvam, R. (2004). *Research methodology.* New Delhi, China: PHI Learning Limited.

Pintrich, P. R. (2003). A motivational science perspective on the role of student motivation in learning and teaching contexts. *Journal of Educational Psychology, 95*(4), 667-686.

Pintrich, P. R., & DeGroot, E. V. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology, 82*(1), 33–40.

Rigby, C. S., Deci, L., E., Patrick, B. C., & Ryan, R. M. (1992). Beyond the intrinsic-extrinsic dichotomy: Self-determination in motivation and learning. *Motivation and Emotion, 16*(3), 165-185.

Rosenshine, B. (1997). Advances in research on institution. In J. W. Lloyd, E. J. Kameenui, & D. C. (Eds), *Issues in educating students with disabilities* (pp. 197-221). Mahway N. J.: Lawrence Earlbaum.

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist, 55*(1), 68-78.

Ryan, R. M., & Deci, E. L. (2009). Promoting self-determined school engagement: Motivation, learning, and well-being. In K. R. Wentzel, & A. Wigfield, *Handbook of motivation at school* (pp. 171-196). New York: Routledge.

Ryan, R. M., Connell, J. P., & Plant, R. W. (1990). Emotions in nondirected text learning. *Learning and Individual Differences, 2*(1), 1–17.

Sandler, M. (1998). *Career decision-making self-efficacy and an integrated model of student persistence in a continuing higher education adult degree program.* New York: New York University.

Schunk, D. H., & Zimmerman, B. J. (2007). Influencing children's self-efficacy and selfregulation of reading and writing through modeling. *Reading & Writing Quarterly, 23*(1), 7–25.

Schunk, D., & Pajares, F. (2002). The development of academic self-efficacy. In A. Wigfield, & J. Eccles, *Development of Achievement Motivation* (pp. 16-43). San Diego: Academic Press.

Seifert, T. L. (2004). Understanding student motivation. *Educational Research, 46*(2), 137149.

Sharpe, R. M. (2012). *Secondary school students' attitudes to practical work in school science.* Unpublished PhD Thesis, University of York Education .

Stipek, D., Feiler, R., Daniels, D., & Milburn, S. (1996). Effects of different instructional approaches on young children's achievement and motivation. *Child Development, 66*(1), 209–223.

Thungu, J. (2008). *Mastering PTE.* New York: Oxford University Press.

Tomazic, I. (2009). The influence of direct experience on pupils' attitudes to, and knowledge about amphibians. *Acta Biologica Slovenica, 51*, 39-49.

Tomkins, S. P., & Tunnicliffe, S. D. (2001). Looking for ideas: Observation, interpretation and hypothesis-making by 12 year old pupils understanding science investigation. *International Journal of Science Education, 23*(8), 791-813.

Trowbridge, L. W., Bybee, C. J., & Powell, J. C. (2000). *Teaching secondary school science.* Upper Saddle River, NJ: Merrill/Prentice Hall.

Turner, J. C. (1995). The influence of classroom contexts on young children's motivation for literacy. *Reading Research Quarterly, 30*(3), 410–441.

Umeh, M. O. (2002). Reducing teachers' instructional difficulties in some content areas of some senior secondary school Biology curriculum for sustainable development. *Proceedings of the 43rd annual conference of the Science Teachers Association of Nigeria.*

United Nations Educational Scientific and Cultural Organization, (. (n.d.). *Basic Learning Materials Initiative.* Retrieved june 14, 2016, from http://www.unesco.org/education/blm /chap1_en.php

United States Agency for International Development. (2002). *"USAID Outlines Afghan Reconstruction Programs.".* Retrieved june 14, 2016, from http://www.reliefweb.int

Validya, N. (2003). *Science Teaching for 21st Century.* New Delhi: Deep & Deep Publication PVT. Ltd.

Von Secker, C., & Lissitz, R. (1999). Estimating the Impact of Instructional Practices on Student Achievement in Science. *Journal of Research in Science Teaching, 36*(10), 1110-1126.

Wambui, S. E. (2013). *Effects of use of instructional materials on learner participation in science classroom in preschool in Kiine zone Kirinyaga country Kenya.* Nairobi: University press, Nairobi.

Wellington, J. (2000). *Educational Research: Contemporary Issues and Practical Approaches.* London: Continuum.

Wellington, J. (2005). Practical work and the effective domain: What do we know, what should we ask, and what is worth exploring further? In S. Alsop, *Beyond Cartesian Dualism: Encouraging affect in the teaching and learning of science: Science and education library* (pp. 99-110). New York, NY: Springer.

Wenglisky, H. (1998). *Does it Compute: The Relationship Between Educational Technology and Student Achievement in Mathematics.* Princeton, NJ: Educational Testing Service. Retrieved from www.ets.org/research/pic

Wenham, E. D. (1984). *Physics: Concepts and Models* (2nd ed.). London: Longman.

West Africa Examinatios Council. (2015). *Students' Performance in Examination Under Review.* Accra: West Africa Examinations Council. Retrieved December 12, 2016, from http://waeconline.org.ng/e-learning/Physics/Phys3224mw.html

West African Examinations Council. (2014). *Students' Performance in Examination Under Review.* Accra: West African Examinations Council. Retrieved June 15, 2016, from http://waeconline.org.ng/e-learning/Physics/Phys3224mw.html

Wikipedia. (2015). *The international free space encyclopedia: Improvisation.* Retrieved from http://en.wikipedia.org/wiki/improvisation

Woodley, E. (2009). Practical work in school science: Why is it important. *School Science Review, 91*(335), 49-51.

Woolnough, B. E. (1998). Authentic science in schools, to develop personal knowledge. In J. Willington, *Practical work in school science: Which way now?* (pp. 109-125). London: Routledge.

Yandila, C., Komane, S., & Moganane, S. (2003). *Towards learner-centred approach in senior secondary school science lessons.* University of Botswana: Department of Mathematics and Science Education.

Zhaoyao, M. (2002). Physics Education for the 21st Century: Avoiding a Crisis. *Physics Education, 37*(1), 18-24.

# Appendix A
## Pre–Test

NAME OF STUDENT:……………………………………………………………

NAME OF SCHOOL: ……………………………………………Duration: 40 mins

*Please, you are required to answer all the questions; each question carries one (1) mark*

1. Magnetic flux density is defined as the

    A. Total number of magnetic lines of force surrounding a magnet
    B. Number of magnetic lines of force per unit area normal to the magnetic field
    C. Strength of the magnetic field surrounding a current – carrying conductor
    D. Magnetic force exerted on a unit magnetic pole

***10−7*** □***2*** has a resistance of ***2.2 Ω*** calculate its resistivity

| | |
|---|---|
| ***10−7*** m | ***107*** m |
| ***10−7*** m | ***107*** m |

3. In a uniform electric field, the magnitude of the force on a charge of 0.2 C is 4 N. calculate the electric field intensity

| | |
|---|---|
| □ □***−1*** | □ □***−1*** |
| □ □***−1*** | □ □***−1*** |

4. The region around a magnet in which the magnetic influence is experienced is called

    A. Magnetic flux
    B. Magnetic field
    C. Magnetic meridian
    D. Magnetic declination

5. An el

6. ectric bulb is rated 60 W, 220 V. Calculate the resistance of its filament when it is operating normally

   A. 296.7 Ω
   B. 400.0 Ω
   C. 512.2 Ω
   D. 806.7 Ω

7. Magnetic saturation occurs if the magnet

   A. Is demagnetised
   B. Is magnetised by striding
   C. Is at its maximum magnetization
   D. Has an unbalanced magnetic domain

8. The function of the capacitor in a rectifier circuit is to

   A. Pass all a.c signals
   B. Filter off the a.c signals
   C. Filter off the d.c signals
   D. Pass all d.c signals

9. Which of the following statement about an electromagnet is not correct?

   A. It is a temporary magnet
   B. Its strength depends on the magnet
   C. Its strength depends on the number of turns in its coil
   D. It has permanent poles

10. The angle between the geographic north and the magnet north is called

   A. Angle of dip
   B. Angle of declination
   C. Magnetic meridian
   D. Angle of variation

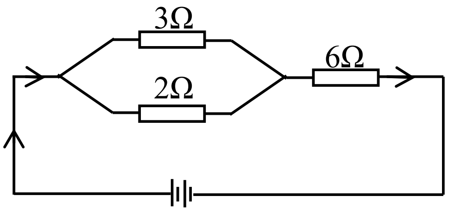
11. A transformer with 5500 turns in its primary is used between a 240 V a.c supply and a 120 V kettle. Calculate the number of turns in the secondary.

   A. 11000
   B. 2750
   C. 460
   D. 232

$\boldsymbol{105}$ ▯▯$\boldsymbol{-1}$ at right angle to a uniform field of flux density 0.5 T. Calculate the force on the charge due to the field

A. 0.5 N
B. 5.0 N
***105*** N
***106*** N

*Use the diagram below to answer question 12 and 13*




13. In the diagram above, the current passing through the 6 Ω resistor is 1.5 A. Calculate the current in the 3 Ω resistor

A. 1.20 A
B. 0.75 A
C. 0.90 A
D. 0.60 A

14. Calculate the terminal p.d of the battery in the diagram

A. 7.50 V
B. 10.80 V
C. 9.00 V
D. 11.52 V

⍰⍰**cos**(⍰⍰ + *Ø* is called the

A. Phase of the current
B. Peak value of current
C. Amplitude of the current
D. Root – mean – square valve of the current

16. In which of the following devices is the principle of electromagnetic induction applied?

I. D.C motor
II. Transformer
III. A.C generator

A. I and II only
B. I and III only
C. II and III
D. I,II and III only

17. Calculate the magnetic flux through a square coil of size 10 cm set with its plane at $60^0$ to the field of flux density 1600 T

A. 16 Wb
B. 8 Wb
C. 4 Wb
D. 24 Wb

18. The direction of induced current in a straight wire placed in a magnetic field is determined by using

A. Fleming's right hand rule
B. Maxwell's screw rule
C. Faraday's law
D. Lenz's law

19. The main function of the piece of a telephone is that it convert sound energy to

A. Mechanical energy
B. Electrical energy
C. Chemical energy
D. Thermal energy

20. Find the cost of a 60 W lamp for 24 hours if 1 kWh cost ø5.00

A. Ø14.40
B. Ø12.50
C. Ø7.20
D. Ø2.00

21. Materials which, when placed in a non – uniform magnetic field, experience a weak force tending to move them towards the part of the field are referred to as

A. Diamagnetic
B. Ferromagnetic
C. Paramagnetic
D. Saturated

## Appendix B

## Post – Test

NAME OF STUDENT:……………………………………………………………

NAME OF SCHOOL: …………………………………………… Duration: 40 mins

*Please, you are required to answer all the questions; each question carries one (1) mark.*

1. Which of the following material is non – magnetic?

   A. Iron
   B. Cobalt
   C. Copper
   D. Nickel

are connected in parallel. Calculate the combined capacitance.

**1213**□
**1312**□
D. 9.0 F

3. In which of the following devices is chemical energy converted into electrical energy.

   A. Solar cell
   B. Electrical generator
   C. Dry cell
   D. Nuclear generator

4. A 1,000 W kettle and a 750 W pressing iron are used together for 2.5 hours. If the cost of electricity is ₵5.00 per kWh, calculate the total cost involved

   A. ₵2,2000.00
   B. ₵220.00
   C. ₵202.00
   D. ₵22.00

5. If I is the current in a conductor of length l which is place at right angle to a magnetic field of flux density B, the Force F experienced by the conductor is given by

□□**2**□
□□□**2**
□**2**□□

6. Which of the following energies is stored mainly by an inductor?

A. Chemical energy
B. Electrical energy
C. Heat energy
D. Magnetic energy

7. The point on a magnet around which the magnetic lines of force are closest is the

A. Magnetic flux
B. Neutral point
C. Magnetic pole
D. Magnetic dip

8. A transformer delivers a current of 10 A at 30 V. if the primary of the transformer draws a current of 4 A from 120 V supply, calculate the efficiency of the transformer

A. 160.0%
B. 100.0%
C. 62.5%
D. 37.5%

9. The process of converting an alternating voltage to a steady voltage is known as

A. Filtering
B. Rectification
C. Stabilization
D. Smoothing

10. What is the effect of using splint – ring in a simple d.c motor?

A. The direction of the rotation of the coil reversed
B. The current in the coil flows in the same direction
C. The current in the coil becomes alternating
D. The direction of the force on the coil is reversed

11. Calculate the resistivity of a wire of length 2 m and cross area 0.004 $cm^2$ if resistance is 3.0 Ω

A. 0.0000267 Ω m
B. 0.00006 Ω m
C. 0.26700 Ω m
D. 0.37500 Ω m

12. It takes 4 minutes to boil a quantity of water electrically. How long will it take to boil same quantity of water using the same heating coil but with the current doubled? (Neglect any external heat losses)

A. 64 minutes
B. 32 minutes
C. 8 minutes
D. 4 minutes

13. For resonance in an alternating current circuit, the current must be maximum because the

A. Impedance is minimum
B. Capacitive reactance is zero
C. Impedance is maximum
D. Inductive reactance is zero

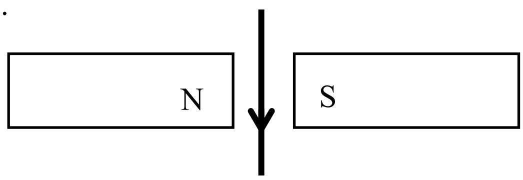
14. The kilowatt – hour (kWh) is the unit of electrical

A. Power developed
B. Current used
C. Energy consumed
D. Resistance offered

15. Which of the following items can be found in the flasher unit of a motor car?

A. Electromagnet
B. Pyrometer
C. Thermocouple
D. Thermostat

16.



The diagram above shows a current – carrying wire between the poles of a magnetic. In which direction would the wire tend to move?

A. Into the paper
B. Out of the paper
C. Towards the north pole of the magnet
D. Towards the south pole of the magnet

17. Electrical fuses are used in domestic wiring to

A. Cut off the mains supply if too high a current flows
B. Prevent electrical shocks
C. Supply electricity to all the electrical appliances
D. Integrate all the circuit

18. The process by which a ferromagnetic substance is magnetized by an external magnetic field is known as

A. Electrostatic induction
B. Magnetic induction
C. Self-induction
D. Mutual induction

19. The purpose of laminating the core of a transformer is to

A. Reduce the number of turns of the coil
B. Increase the magnetic flux linkage
C. Increase the heating effect of the coil
D. Reduce energy losses due to eddy current

20. At resonance in a series RLC circuit, the

A. Capacitive reactance equals zero
B. Impedance is maximum
C. Current is minimum
D. Capacitive reactance equals inductive reactance

## Appendix C

### Answers to Pre–Test and Post–test

| Pre–Test | Post–Test |
|---|---|
| 1. B | 1. C |
| 2. B | 2. D |
| 3. A | 3. C |
| 4. B | 4. D |
| 5. D | 5. B |
| 6. C | 6. D |
| 7. C | 7. C |
| 8. D | 8. C |
| 9. B | 9. B |
| 10. B | 10. D |
| 11. A | 11. B |
| 12. D | 12. D |
| 13. B | 13. A |
| 14. A | 14. C |
| 15. D | 15. D |
| 16. B | 16. B |
| 17. A | 17. A |
| 18. B | 18. B |
| 19. C | 19. D |
| 20. A | 20. D |