UNIVERSITY OF EDUCATION, WINNEBA

THE EFFECT OF USING PLOTS AND GRAPHS TO TEACH MOTION

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2015

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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 requirements for award of a degree of the Master in Science Education

DECEMBER, 2015

DECLARATION

STUDENT'S DECLARATION

I, CHARLES KWAME AMEGBEDZI, declare that this Thesis, with the exception of quotations and references contained in published works which have all been identified and acknowledged, is entirely my own original work, and it has not been submitted, either in part or whole, for another degree elsewhere.

SIGNATURE: …………………………………………………………………………..

DATE: ……………………………………………………………………………………

SUPERVISORS' DECLARATION

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

NAME OF SUPERVISOR: PROFESSOR MAWUADEM KOKU AMEDEKER

SIGNATURE: …………………………………………………………………………..

DATE: ………………………………………………………………………………..

ACKNOWLEDGEMENTS

My sincere thanks go to my supervisor, Professor M. K. Amedeker for sharing his experience, expertise and time with me. His expertise, advice and reviews always added value to my work. My thanks also go for his patience, guidance, suggestions and advice, given me throughout the period of working with him.

I want to thank my family because they were there for me while I struggled through this process. My special thanks to my dear wife Celestine whose encouragement and prayers made it possible for me to be where I am today. For all who always remembered me in their prayers I say God richly bless you.

I would also like to acknowledge the help given to me by my grandmother Madam Ameyo Catherine Etu for her support and encouragement in my formative years, I would never have come this far in my educational experience. I am eternally grateful to you, for instilling in me the ethics of concern for others and exposing me to a multitude of worlds and providing me the educational foundations upon which I continually build upon.

Finally and most importantly, I give the resultant Glory and Honour to God, Who has seen me through this study, for without Him, this study would not have been successful.

DEDICATION

This work is dedicated to my wife, children, friends and all who helped in divers ways to make this work a success.

ABSTRACT

This study evaluated the effect of using plots and graphs to teach the concept motion. The study established the effects of plots and graphs to teach motion. In this study the Researcher taught using charts, diagrams, plots and graphs and the students were taken through a lot of activities. The progress of students was monitored by the Researcher through the use of the activities and the evaluation questions. The study identified students feedback to the questions asked during the Intervention lessons and their contributions made during the lesson. The extent of the intervention strategy on students' concept development in motion and ability to solve using basic formula was determined. The study employed an Action research strategy for the data collection. Charts, diagrams, plots and graphs were used as instructional strategy in teaching five lessons during the intervention period. The strategy was used to teach thirty (30) Form 2 Visual Arts students of the Dzodze-Penyi Senior High School in the Ketu North District of Volta Region of Ghana. This study used teaching and assessment of the learning outcomes as the main instrument for data collection. The findings were that student-teacher and student-student interactions increasingly improved as their ability to ask and respond to questions improved due to the instructional strategy employed as the lessons progressed. Besides, students' participation in the calculations was increased as the charts, diagrams, plots and graphs were used to deduce the formulae. Finally, on the basis of the results obtained in this study, it is concluded that more graphics should be used in lessons so that the lessons can attract more senses for effective concept development in science.

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CHAPTER ONE

INTRODUCTION

1.0 Overview

The study examines the background of the study which deals with usefulness of plots and graphs in the teaching and learning of Integrated Science in Ghana. The Researcher designed interventions such as graphical and diagrammatic illustrations of concepts in Motion to aid students understanding of Integrated Science in second cycle institutions in the country. This chapter is organised under the subheadings background of the study, statement of the problem, purpose of the study, objective of the study, research questions, the significance of the study, limitation, delimitations as well as the organisation of the study.

1.1 Background to the study

The usefulness of graphic organisers in improving teaching and learning cannot be over emphasised as far as designing of Integrated Science curriculum is concerned. Plots and graphs are the visual display of scientific concepts that demonstrate the relationships between facts, concepts or ideas that the teacher wants the learners to acquire. The Integrated Science Syllabus at the second cycle level is loaded with many practical concepts that need new innovations like the use of more illustrations, charts, graphs and diagrams. The final practical examination in the Integrated Science is based on the students' ability to interpret, analyse and plot data on graph sheets. That is, the students can solve practical questions if they were taught how to draw graphs and use graphs to answer questions and use illustrations in charts to explain scientific concepts.

The textbooks are also designed with a lot of pictures, graphs and diagrammatic illustrations hence there is the need for the teachers to move from the old way of giving notes which is only in written words but rather move to explore the new methodology where they brainstorm around the diagram or use plots and graphs to deliver the scientific concepts so that the learners can also actively involved in the learning process and get better understanding from the concepts taught.

1.2 Statement of the problem

Improving the academic performance of the students is very crucial to the teachers and other stakeholders of the education. Teachers must use every possible means to help their students to improve their academic performance in schools.

It is observed that students in SHS performed poorly in integrated science practicals because they lack the basic skills (Ministry of Education, 2010). This assertion is further supported by The Chief Examiner's report on integrated science practicals (paper 3) over the period (2012-2015).It became profound when most Visual Art 2 students of Dzodze Penyi SHS could not applied the basic skills in motion lessons. This may be because most teachers are in hurry to complete the syllabus without recourse to exploring teaching and learning strategies like the use of charts, plots and graphs, diagrams to analyse the key concepts in the chosen science topics they teach. The Researcher is of the opinion that it is possible to explore teaching strategies recommended by the Ministry of Education and still completes the syllabus without recourse to writing notes on the chalkboard for students to copy.

1.3. Purpose of the study

The study investigated the effect of using plots and graphs in teaching the topic motion in Dzodze -Penyi SHS. Students were taught the concept motion using plots and graphs, charts and diagrams. Students were assessed and the impact of the use of charts, plots, graphs and diagrams were noted.

1.4. Objectives of the study

The objectives of the study were to:

1. Ascertain whether the use charts, drawings and graphs help students to solve problems in Integrated Science lessons.
2. Determine the effects of the use of the plots and graphs in learning the topic motion.
3. Identify students' feedback to test items given by the teacher.

1.5. Research Questions

The study specifically addressed the following research questions.

1. In what ways do plots and graphs helped students to solve problems in Integrated Science lessen?
2. What effects do plots and graphs have on learning the topic motion?
3. What are students' feedbacks to plots and graphs test items given by the teacher?

1.6. Significance of the study

The findings of this study could be very important to the various stakeholders of education.

Firstly, it is hoped that the outcome of the use of plots and graphs could be beneficial to students of Dzodze -Penyi Senior High School especially in their academic performance in Integrated Science.

Secondly, other Integrated Science teachers in the school could also use the findings to improve their teaching strategies and technique.

Thirdly, the study could serve as reference for future studies in the use of plots and graphs to aid understanding of students on Integrated Science in the country, Ghana as a whole.

Finally, the findings of the study could improve the existing teaching and learning strategies of Integrated Science in Senior High Schools in Ghana.

1.7. Delimitations

Simon (2011) said the delimitation identifies the boundaries of the study in terms of subject, objectives, facilities, time, area and issues to which the research is focused. The delimitations are the characteristics that are in the control of the researcher in term of the scope of the study and define the boundaries for the study.

This study was limited to Dzodze - Penyi S.H.S. due to time and financial constraints. Easy access to the selected school was also a factor and the topic is to be taught in the second year of the Integrated Science syllabus. The study also concerned itself with only concepts and knowledge associated with motion using plots and graphs

1.8. Limitations of the study

Leedy and Ormrod (2010) defined limitations as conditions beyond the control of the researcher that will place restriction in the validity of the study. This study was intended to cover all the form two classes in Dzodze Penyi Senior High School but due to time and financial constraints the study was limited to Visual Art 2 students only. The Senior High Schools in the district are far from each other hence the Researcher is limited to one school. Generalised could be difficult due to the sampling technique used.

CHAPTER TWO

REVIEW OF THE RELATED LITERATURE

2.0 Overview

This chapter deals with the review of literature related to the study. The innovative instructional techniques in teaching and learning science with preference to concept mapping, the use of information communication technology (ICT), improvisation and cooperate learning are treated. Graphic organisers and its use to improve learning and retention of science have been discussed. The review also discusses the importance of plots and graphs in science as well as the basic skills in graph plotting. Another area covered under this chapter is the theoretical framework of a research work.

2.1 Instructional Techniques in Science

Teaching strategies are techniques, styles and the manner in which a teacher effectively and efficiently interacts within the classroom environment to bring about quality learning of subjects among students. Amount of learning that takes place in a student greatly depends on the instructional techniques and the learning styles of the students. The method of teaching is regarded as the vehicle through which the learning outcomes are delivered (Danmaigoro, 2005). A teacher must recognise the diversity in learning style among students in a class and adapt strategies that can effectively suit the students (Erinosho, 2008). Erinosho further pointed out that a good teacher is expected to apply a range of active learning approaches that incorporate other broad based strategies that will cater for the differences and similarities in learning styles.

Erinosho (2008) is of the view that a single lesson may be taught using a combination of the techniques which will engage students' practical work, discussion, demonstration, hands on group work, lecture and questioning.

Njoku (2004) suggests that it has become necessary to seek innovative learning strategies to enhance the quality of instruction and learning of science. These innovative strategies include the cooperative learning, concept mapping, information communication and technology and improvisation. For the purpose of this study all the innovative strategies will be briefly discussed.

Concept Mapping

Concept mapping is also another instructional strategy that involves the use of diagrams in which concepts are organised in hierarchy (Efe, 2008). This learning strategy is useful in facilitating meaningful learning and it has been used to evaluate learning and study skills leading to meaningful learning and achievement in science (Kim, 2000).There are strong support of concept mapping as an innovative learning strategy that can be used by teachers and their students. To make science learning more meaningful by assisting students to organise incoming information and constructing mental bridges between what is already known and what is to be learned.

Asan (2007) found significant differences in achievement scores for experimental group using a concept mapping strategy and a control group using traditional instruction. Subjects included 120 high school physics in the 5 intact classes. The experimental group constructed maps prior to learning, and subsequent to studying the concepts, while the control group received only traditional instruction.Asan indicated that students who participated in constructing concept maps out performed their control group counterparts.

Ludo, Jam, Jacqueline, Luc, Ina, Liesbeth, and Heidi (2001) also investigated the impact of concept mapping and visualisation on the learning of school chemistry in Belgium using 80 final year students from five classes in two secondary schools. They reported that there were no significant differences in achievement of the concept maps on the experimental groups and the control groups. They concluded that concept maps and visual aids produce the same learning effect on the students.

The Use of Information Communication Technology

Another modern instructional technique teaching science is the use of information communication and technology. Afolabi (2005) defines information communication and technology as the creating, processing, storage, retrieval and transmission of data and information including telecommunication, satellite, technologies and the global system of mobile communication (GMS). Musa (2005) outlined the following ways the science teacher can be assisted by ICT are laboratory data analysis, stimulating and modelling, drill and practice and record keeping. Abubakar and Rilwanu (2010) also said ICT solidifies the link between experiment and theory and provide improved learning. There are many advantages of using ICT as an instructional strategy. It has been observed that students' learning rate is faster using computer assisted instruction (CAI) than with conventional instruction and this enhanced learning rate is accompanied with high retention (Ojo, 2005).ICT programme used independently of teacher and peer input and used without other. Kim (2000) conducted a study to determine the effects of a cognitive mapping strategy using ICT against a traditional lecture method. Kim used middle school students with mixed ability from urban district. The samples were grouped into experimental and control groups each of 15 students. Both groups were given the same pre-test and post-test. The experimental group was to use a cognitive mapping strategy that self-guided the students step-by-step and the control group was taught with a traditional lecture method. The findings of the research revealed that the experimental group showed significant gain in comprehension as compared to the control group.

Improvisation of Teaching Learning Materials

Improvisation is another innovative that teachers can use to improve upon the process skills of the learners. Improvisation is the process of devising a solution to a requirement by making do, despite the absence of resources.

According to Bugaje (2008), the need for improvisation arises due to inability to provide the materials needed for students' population. The need also arises due to high cost for standard equipment, shortage in the availability and production of known standard equipment, the need to promote scientific thinking and the inability to internalise science processes and skills (Bugaje,2008). It is the duty of science teachers to identify and enumerate the resource available in his environment, organised and managed them for effective teaching. This may improve the quality of science education as improvisation developed functional knowledge and manipulative skills. According to Ibrahim, Paulina, Abubakar and Abdulkadir (2000) improvisation provides consistency and meaningful learning, facilitates originality, achieve the three domains of learning, and encourage self reliance and self independence. .

Students' centred style of teaching is most effective for teaching the process of science than the product. It focuses on student cognitive abilities and their interest (Ibrahim et al., 2010). The teacher focuses on how to make students responsible for their own learning by making them take an active role in the learning process. Erinosho (2008) stated that, there are range of techniques for creating a student centred and active classroom atmosphere such as questioning, discussion, collaborative and inquiry methods of learning.

Moore (2003) reported that notwithstanding the effectiveness of student centred instructional approach in science no single teaching technique is enough to fulfil all the needs of a student in a class. An effective teacher is therefore requested to use several teaching techniques to initiate quality science teaching and learning (Erinosho, 2008).

According to Agusiabo (2002) the use of improvisation as a teaching and learning technique promotes senior secondary school science academic achievement. A total of 10 students were involved in a study. The researcher divided the students into two groups: the experimental and control group each of 30 students. The experimental group was exposed to teaching that required the teacher and the students to improvise the materials in an experiment. The control group was introduced to the concept using expository techniques. Results from the post-test questions revealed that the experimental group outperformed the control group in all questions. The researcher concluded that, the use of improvisation of teaching learning materials enhanced students understanding of the topic acid base and salts.

Cooperative Learning

Cooperative learning is a successful teaching strategy in which small groups each with students of different ability levels, use a variety of learning activities to improve their understanding of a subject e.g. group work, project work, team-teaching, group quizzes, hand on activity. In addition, these techniques can also increase students' interest in a subject and enhance their self-esteem. Adeyemo (2010) defines cooperative learning as a teaching strategy in which students work together in small groups and use a number of activities to enhance the understanding of their academic objectives. Furthermore, Adeyemo observed that cooperative learning strategy provides cognitive information between students and motivate students to share ideas. Adeyemi (2010) also stated that cooperative strategy is most useful than other instructional strategies.

2.2 Graphic Organisers in Science

Graphic organisers are visual displays that depict the relation between facts, terms and ideas with a learning task in science (Hyerle, 2000). These visual organisers have been linked to ways that scientific information is to be presented and learned. Lee and Nelson (2005) stated that organisers are tools that have been used for many years and have been changed to fit the specific curricula, levels of the students, subject matter and lesson planning.

Learning is extremely effective when students can connect new information with past experiences. Salinger (2003) pointed out that the graphic organisers, like comparison charts, will help students to express ideas in a visible or perceptible way in order to process new information.

Howard (2005) stated that graphic organisers aid students in bringing forth prior scientific knowledge as well as linkages between prior knowledge and new information. Graphic organisers have been found to enhance learning in at least three stages.

Prior to reading, graphic organisers can be used to familiarise themselves with the information in the text as well as to allow students to acknowledge and share their understandings of the lesson objectives. They can also be used to enhance students prior knowledge of the topic being discussed (Howard, 2005). The use of different graphic organiser in science lessons will allow critical thinking and transform scientific concepts and ideas into visual and graphical displays (Howard 2005). Sinatra (2000) stated that scientific graphic organisers will help students to form mental pictures of concepts taught in class and this will reduce forgetting. Graphic organisers can help teachers to make significant difference in the vocabulary and contextual retention in their subject matters.

In a study conducted by Ermis (2008) fifth-grade students were tested in skeletal system. Traditional instructional group gained an average of 35% from pre-test to post-test, while the graphic organiser group gained an average of 45% from pre-test to post-test. The use of graphic organisers using secondary students in science was effective when a study compared the use of teacher-directed graphic organisers and self-study using graphic organisers. The students in general education scored an average of 86% with teacher direction and 56% with self-study. This study reinforces the results from the results from the previous study in proving that the use of graphic organisers in acquiring information is beneficial, but also furthers the research in finding that graphic organisers are more effective when taught and explained by a teacher.

Kroll and Paziotopulos (2004) researched into the effectiveness of graphic organisers using concrete model assists study to develop and internalise their cognitive skills. The study was conducted to determine the effect of graphic organisers on secondary school science concept skeletal and muscular system. Forty students were selected and divided into 20 each. The pre-test and the post-test were given to the groups accordingly. The experimental group was taught using graphic organisers based on the skeletal and the muscle system. The control group was taught with lecture with power point. The researcher saw a significant difference in the performance of the post test of the student. The experimental group had mean of 73 while the control group had mean of 50. The researcher concluded that graphic organisers were very effective strategy to use to teach science concepts.

2.3 Construction of Graphic Organisers

A graphic organiser consists of spatial arrangements of words intended to represent the conceptual organisation of text. According to Stull and Mayer (2007) the main purpose of graphic organisers is to arrange scientific concepts in such a way to be meaningful to the learner. There are large assortments of graphic organisation depending on the scientific concept the teacher wants to teach. Chang, Sung and Chen (2002) stated that concept maps, webs, plots and graphs can be created with software such as Inspiration and Active Inspire. This software will allow both students and teachers to link pictures and words in lessons for easy retention by the help of visual stimulation. According to Stull and Mayer (2007), visual organisers increase the activities of the learners in line with the levels of the Bloom's Taxonomy.

Aggarwal (2007) affirmed that visual, audio and synchronised graphics when designed and introduced at the right stage of the lesson will stimulate several senses thus making the learners more involved in the learning process. For instance the use of computer simulations to project the concept conservation of momentum helps students to see and hear the cars colliding hence calculation of momentum before and after will be easy for the students.

Scientific models are also refers to as thinking tools that encourages students to build meaningful metal representations of abstract ideas (Harrison, 2003). For example students use models to understand molecular shapes, explanation of collision theory and visualise the states of matter. Graphic organisers if well integrated with models in science lessons will cause in tremendous performance of the students because it rinks the schema of the students to the new task (Duschi, 2000).

Grant (2009) proposed experiential learning cycle as a model of learning with reflection as a key element supporting the process of learning. It is important to emphasised that a good graphic organiser must include models to help students to use the lesson visualise and conceptualise the key information in the teaching and the learning process.

Graphic organisers if well administered in the teaching and learning will help foster the understanding of science and hence improve the student's ultimate outcomes of the result (Struble, 2007). There are four main categories of graphic organisers namely webs, concept maps, mind maps and plots and graphs.

2.4 Use of Graphic Organisers to Improve Learning and Retention

The use of graphic organisers aids students in connecting newly gained knowledge to prior knowledge (McMackin&Witherell, 2005). Gholson and Craig (2006) commented on the importance of prior knowledge by saying learners experience new phenomena, interpret experiences, and reflect on the reasoning process itself. When discussing the activation of prior knowledge, it is suggested that when the student has the chance to link new concepts with ideas that they have already processed and stored on in long-term memory, the students is granted an occasion in which to search for relationships which have been stored in the brain, making learning less complicated and more significant.

It was suggested by Jenson (2005) that it is essential for teachers to be knowledgeable about how the brain makes sense out of information; it is therefore very important to keep students to activities where they are made aware of the big picture. Zull (2002) shows that abstract and theoretical ideas have insufficient meaning if no neuronal networks are stimulated by the learners' own concrete experiences. When graphic organisers are used to create a structure of prior knowledge, the student has enough time to enhance his brain for the information he is about to learn. It is very important for the student to participate in the learning process, and no one can lend a hand with this duty better than the teacher. The teacher does this by modifying the lesson to where the learner must focus on prior knowledge. Graphic organisers provide signs that permit students to bring back information that has been stored in memory (Goddard, Pring, &Felmingham, 2005). Stored information is connected to newly gained concepts, which creates relational knowledge that results in more robust comprehension (DiCecco& Gleason, 2002). As students review using a graphic organiser that has been studied in the past, the review causes prior knowledge to be activated which has been stored in the student's memory. Students are able to remember and discuss information as they visualise graphic organisers that have been committed to their memory (Ben-David, 2002). When prior knowledge is activated this is using graphic organiser, and studies have shown that comprehension of the material essentially increases over time .The use of graphic organisers impacts student study by providing them with a place to focus on how concepts are interviewed with each other instead of focusing on making specific association or memorising isolated conceptual facts (Chang, Sung & Chen, 2002). This visualisation of the material helps the students to learn information in the curriculum overall instead of in pieces.

2.5 The Importance of Plots and Graphs in Science

A plot is a graphical technique for representing a data usually as a graph showing the relationship between variables. Graphs are visual representation of the relationship between variables. Graphs are very useful for human beings who can quickly derive an understanding from a data, chats, drawings and graphs which will not come from list of values (Bugaje, 2008). Plots and graphs offer students multiple ways to visualise and investigate data and use it to relate to new ideas in our everyday life. Howard (2000) stated that as students organise and analyse data, they ask questions and dig deeper to solve problems. Plots and graphs help us to move from mere memorising scientific concepts and facts to acquiring the skills of reasoning, inquiry and communication (Efe, 2008).

Building data literacy in science makes one to be richer and have more meaningful experiences in teaching and learning of science. Crawford and Adler (2002) also gave importance of plots and graphs as a tool for helping students to use data to connect school subject with real world events and hence making learning interesting.

The use of plots and graphs in science helps students to develop deeper content knowledge and strengthen critical thinking. Struble (2007) stated that plots and graphs will help students in science to do the following, formulate questions, collect and organise data systematically, identify patterns and discover relationships, develop conclusions and make recommendations based on data analysis. To conclude, plots and graphs if well used in lesson will increase retention, makes our lesson interesting, increase students understanding and also increase the inquiry and communication skills of the students.

2.6 Skills in Graph Plotting.

There are two skills needed in graph plotting, namely graph construction skills and graph interpretation skills. Kwon (2002) defines graphing as having three graphical components skills. These components are transforming, interpreting and modelling.

Transforming- is the ability to see and draw a variety of graphs depicting the same event. Example, plotting a distance- time graph to predict the velocity-time graph of the same event.

Interpreting- ability to translate from graphs to verbal expressions.

Modelling- ability to translate real world situation to graphs. Lapp and Cyrus (2000) identified areas of difficulties students have with plots and graphs and measured graphing ability of students in the context of connecting graphs with physical concepts, connecting graphs with the real world.

According to Asabere-Ameyaw and Haruna (2004) graphs provide information that would otherwise not be appreciated at a glance. Graphs are used to explain certain concepts or ideas across a discipline or a field of study. For example, the verification of Ohm's law, Kwon (2002) stated that plots and graphs represent a key symbol system of the world in the natural science. However, plots and graphs help student to learn straight line graph in integrated science and developing new skills of interpreting complex graphical problems.

2.9 Theoretical Framework

According to Leedy and Ormrod (2010) theoretical framework guides the research, determining what to measure and what statistical relationship should be used. The theoretical framework is a conceptual model that establishes a sense of structure that guides one's research. It provides the background that supports investigation and offers the researcher a justification for the study of a practical research problem. It includes the variable that one intends to measure and the relationship it seeks to establish. The theoretical framework is the presentation of a theory that explains a particular problem (Creswell, 2009).

Troachim (2006) stated that there are two realms involved in research that is theory and observation. Theory is what goes on inside the head of scientist whiles observation is what goes on in the real world. In conducting research one works between the theory and observation. The theory guides every aspect of the research from formulation of the research questions through operationalisation and discussion. Theoretical framework connects the research to the existing knowledge by providing a basis for the hypotheses and the choice of methods. Rogers (2003) explained that theoretical framework is a term used to describe the theories on which a study is grounded. It is a summary of the theory regarding the problem that is being investigated. Camp (2001) stated that theoretical framework is an explanation about a phenomenon. It provides additional clarity by stating a theoretical framework and provides the researcher the lens to view the world.

Development of the theoretical framework helps to clarify the implicit theory and clearly defines the theory. The theoretical framework helps to reduce biases that may sway the researcher's interpretation. Theoretical framework is selected on the basis of how best it can explain the relationships among variables and should link to conceptual framework, operationalisation and instrumentation.

In this study the Researcher developed a theoretical framework that uses teaching with graphic organisers such as charts, pictures, plots and graphs as well as good hands-on activities to improve students understanding of motion in integrated science.

This study was based on cognitive learning theories relating to the use of graphic organisers. Several cognitive theories in particular lend support to the use of graphic organisers which help students process and retain information. Schema theory, dual coding theory and cognitive load theory provide the basis for explaining the characteristics of graphic organisers that support the learning process in classrooms. According to Schema theory, memory is composed of a network of schemas. A schema is a knowledge structure that accompanies metal process (Winn &Shyder, 2001). Schema provides contexts for how new experiences are interpreted and how information is interpreted is based on existing schemas.

According to Dye (2000), graphic organiser has its roots in schema theory. When students learn new concepts, they must be able to retain the information for later use. Knowledge is stored in a scaffolded hierarchy as a way of organizing information. Student encode, store and retrieve learned information based in this hierarchy. Graphic organisers make it easier to link new information to existing knowledge and help students build the schema they need to understand new concepts (Guastello, Beasley & Sinatra, 2000). If prior knowledge is activated the schema will able to provide a framework to which new information can be attached and comprehension will be improved. The dual coding theory of learning assumes that memory consist of two separate but interacted systems for processing information (Sadoski & Paivio, 2004). One system is specialized in processing non-verbal imagery and the other is specialised in dealing with language. Dual coded information is easier to retrieve and retain because of the available of two mental representations, verbal and visual. The more students use both forms, the better they are able to think about and recall information (Marzano, Pickering & Pollock, 2001). The use of graphic organisers helps students generate linguistic and non-linguistic representations. As a visual tool graphic organisers help students process and remember content by facilitating the development of imagens and logogens thereby dual coding the information

(Morozano, Pickening & Pollock, 2001). The theoretical framework of this study is also based on cognitive load theory. Cognitive load is the amount of metal resources necessary for information processing (Adcock, 2000). Cognitive load theory maintains that working memory can deal with limited amount of information and its capacity is exceeded, the information is likely to be lost. Visual learning tools such as graphic organisers can reduce the cognitive load and as a result allow more working memory to attend to new materials. (Adcock, 2000). As a result content can be addressed at a more sophisticated and complex levels through the use of graphic organisers in science lessons.

The use of graphic organisers to teach science concepts have their root in Ausebel's theory of learning which belief that students existing knowledge greatly influences students learning. Ellis (2001) stated that when the organisation of a topic becomes apparent, reading skills, writing skill, communication skills are subject to improve with the use of graphic organisers

The study is also rooted in constructivism which believes that cognition makes sense of an individual's subjective experiences and constructs mental structures of the experiential world. The construct of metal structures grow within the context of our social and cultural experiences. Students use their existing knowledge and the new information presented to construct new knowledge.

Piaget's constructivist approach states that children are active learners and construct knowledge upon their previous knowledge on their own through personal interaction and experiences. Piaget believes that construction of knowledge and learning involves two complementary processes thus assimilation and accommodation (Johri, 2005).

The constructive theorists have supported the theory of concept development based on object manipulation and representation. These theories are evident in classrooms where physical manipulation has become the mode of science instruction by the use of real objects, charts and graphs. The graphic organisers as a teaching and learning strategy fit in to the ideas of constructivist. It excites and sustains the interest of learners and enables learners to acquire new skills. Nicoll, Francisco and Nekleh (2001) stated that graphic organisers have been used widely as a constructivist learning model and it is more widely accepted in science education. Constructism posits that learners are not passive receivers of knowledge, but actively construct meaning in their own minds (Good & Brophy, 2000). Science educators must be resourceful by planning their lessons based on the learning theories that can foster effective learning. The Figure 1 shows the strategies the Researcher wants to use to investigate the cognitive and the constructive learning of students in class.

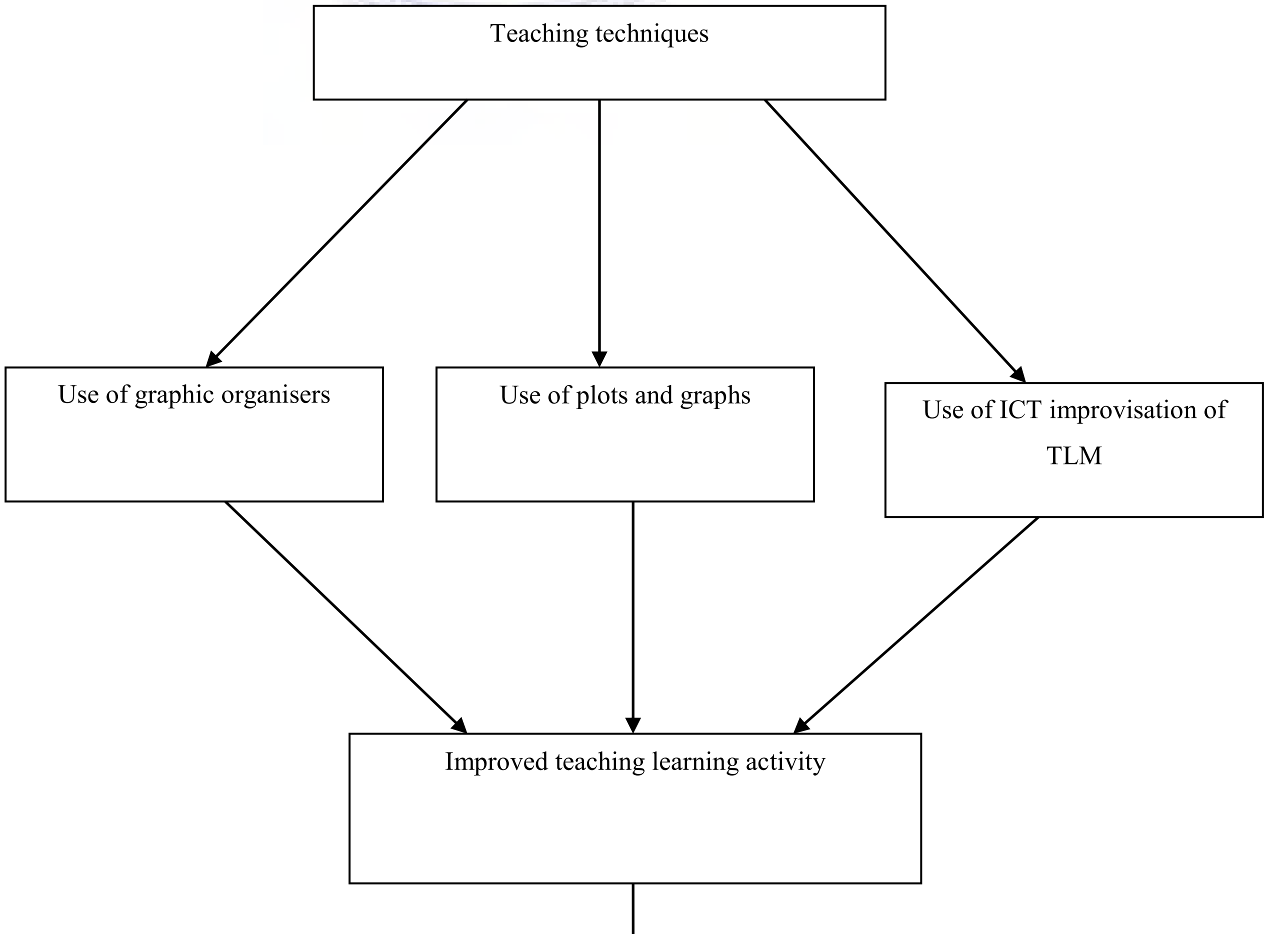

Fig. 1: Theoretical framework of the study.

The Researcher designed a theoretical framework which is based on the cognitive constructivist learning theories of learning. The framework is based on the use of innovative teaching techniques such as diagrams, charts, plots and graphs, use of ICT and improvisation of teaching learning materials. From Figure 1 the innovative techniques were based on constructivists' activities such as measuring distances, recording their corresponding time, working in small groups, recording data and using data to plot a graph helped students to actively participate in the lessons by constructing the ideas themselves. These improved teaching activities helped students to interact with the learning materials and discover the key ideas in the learning process for better comprehension. Constructivism activates the students' inborn curiosity about the real world to observe how things work. The teacher helps the students through problem solving and inquiry based learning activities with which students formulate and test their ideas, draw conclusions and inferences and pool and convey their knowledge in a collaborative learning environment (Yore, 2001). The progress of the students was checked through assignments, group works and individual participation in lessons as well as the use of effective classroom practice and feedback techniques. Graphic organisers have many uses in the classroom and can be used across the curriculum and in increasing patterns of complexity (Moore, 2003). Students are able to learn how to learn while they are in the process of gaining new knowledge. Visual organisers generate and unveil models of interrelationships developed by learners along with the unique patterning capacity of each learners mind. Graphic organisers are used to rediscover information, ideas and experiences that may have become cognitively disconnected.

The stage1 talks about the innovative strategies such as the use of charts, diagrams, plots and graphs, cooperative learning, use of ICT and improvisation of TLMs. The Researcher developed some activities which ware used in teaching and learning of the concept motion in the classroom as shown in stage 2.The learning activities help students to work in groups, measure distances, displacement and velocity, read the corresponding time intervals, represents data in graphical form and use computer simulations to illustrate the calculation of conservation of momentum. These activities motivate the students to get involved in the lessons. Students contribution, questioning and how they apply the straight line graphs to solve new problems such as finding slope of straight line graph and deduce what the slope represent was what the Researcher illustrated at stage 3 as improved students understanding of motion. The final stage deals with the assessment of the innovative strategies through written tests. Students' performance was improved because students' marks ware very high as compared to other classes that did not use the innovative strategies. In all the four stages the researcher used feedback techniques to assess the students' progression and their comprehension. This improved performance by the students depends on the innovative strategies, the learning activities, the teaching learning materials and the evaluation questions. The framework is interconnected to present lessons in a unified and a holistic manner.

CHAPTER THREE

METHODOLOGY

3.0 Overview

This chapter presents the methodology employed for the study. It focuses on the design chosen for the study. The chosen design is divided into three phases namely permission phase, intervention phase and report writing phase. The population drawn for the study was also discussed with much emphasis on how the sample size was obtained and the need to use the sample size. Thirty (30) form 2 visual arts students of DzodzePenyi SHS of Ketu North District of the Volta Region was the sample selected. The instruments used for data collection includes diary of records which was used for recording classroom proceedings on daily bases. The students' notebooks and exercise books were inspected for their performance in the exercises at end of the intervention lessons. Finally, data collected were analysed to find the effects of using plots and graphs on teaching and learning of motion.

3.1 Research Design

A Research Design is defined as the overall plan for collecting data in order to answer the research questions (Creswell, 2007). There are various research designs in various jurisdictions of research work and the choice of a design depends on the aims of the study. According to Amedahe (2002) a research design is a plan or blue-print that specifies how data relating to a given problem should be collected and analysed. Research design deals with specific data analysis techniques or methods that the researcher used (Fraenkel&Wallen, 2000). A research design refers to the overall strategy that integrates the different components of the study in a coherent and logical way, thereby, ensuring effective addressing of research problems; it constitutes the blueprint for the collection, measurement, and analysis of data (De Vaus, 2001).

Some of the different types of research designs are Action Research design, Survey Research design, Case Study Research design, Experimental Research design and Descriptive Research design. The design chosen for this study is the Action Research design.

Action Research

According to Parsons and Brown (2002) action research is a process in which a practitioner studies a problem scientifically, evaluates, improves and make decisions.

Action Research is a participatory process concerned with developing practical knowing in the pursuit of worthwhile human purposes. It seeks to bring together action and reflection, theory and practice, in participation with others, in the pursuit of practical solutions to issues of pressing concern to people (Bradbury & Reason 2003). Action research is a research that aims at closing up gaps between research and practice rather than producing knowledge.

Action Research is described as on the spot procedure designed to deal with a concrete problem located in an immediate situation (Cohen, Marion & Morrison 2007). Action Research aims at contribution to the practical concerns of people in an immediate problematic situations and further look at the ways of solving the problem. According to Bradbury and Reason (2003), Action Research involves the deliberate manipulation of an intervention in order to determine its effect. This study is an action research which seeks to find the effect of using plots and graphs to teach motion.Action research was chosen because the Researcher wants to help the visual art two studentsto overcome their learning difficulty.

Action Research was chosen for this study because it will improve the Researcher's instructional strategies in teaching the concept motion and Action Research will expose the students to innovative learning styles in motion. The interventions will help the students to overcome the learning difficulties they have in the concept motion. Action Research will help the teacher to bridge the gap in knowledge with respect to the students understanding of the concept motion. Action Research will help the Researcher to manipulate the interventions deliberately to bring the desired learning outcomes in students. According to Cohen, Manion and Morrison (2007) action research helps to diagnose a problem in a specific context and attempt to solve the problem in the same context.

In this study Action Research was chosen as the research design and it is divided into three phases as illustrated in Figure 2 below. The phase one was used to interact with students and teachers and also to prepare lesson notes. The second phase was used to teach the intervention lessons using charts, plots, graphs, concept maps and illustrations. The final phase was used to analyse data and write report.

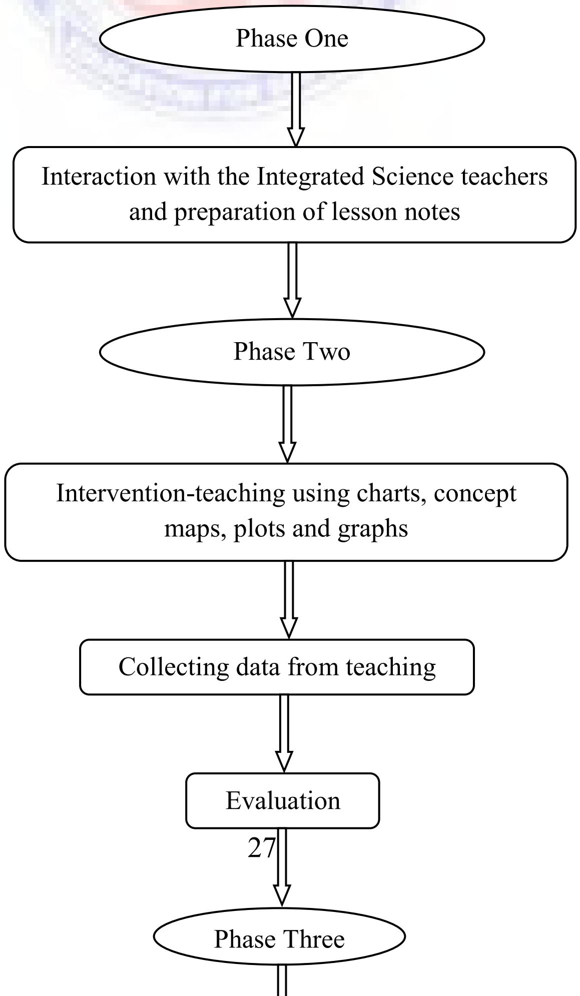

Figure2: Data collection procedure

3.2 Population

A research population is a group of elements or cases, individuals, objects, or events that conforms to specific criteria and to which a researcher intends to generalise the results of research. Castillo (2009) also defined a research population as a large well-defined collection of individuals having similar features. According to Neuman (2003), population refers to the name for a large general group of many cases from which a researcher draws a sample.

Types of Research Population

There are two main research population types. These include the target population and the accessible population. Castillo (2009) also differentiates between two types of population, the target population and accessible population.

Target Population

Target population refers to the entire group of individuals or objects to which the researcher is interested in and would like to generalise the results for the study (Ary, Jacobs & Razzarieh, 2002; Castillo, 2009). According to Punch (2006), it is the target group of people about whom a researcher wants to develop knowledge.

The target population usually has varying characteristics and it is also known as the theoretical population. The target population in this study was the senior high students in the Ketu North district. The target population was the population the Researcher would ideally like to generalise to.

Accessible Population

Accessible population is the group of subjects that is available to the researcher for a study from which the study sample can be drawn (Ary et al 2002; Castillo, 2009). Experimentally accessible population is the group that a researcher actually can measure. Budgetary constraints, for example, often limit the number of students a researcher can study, making the experimentally accessible population much smaller than the target population. Physical limitations also often force a researcher to study groups that are smaller than the target population. For example, interviewing every student in Dzodze Penyi SHS is very difficult and it would consume time. Therefore the Researcher must select a smaller group for the study. The accessible population in this study was the visual Art two students in the Dzodze Penyi SHS.

3.3 Sample

A sample is a smaller group which is drawn from a larger population and studied (Robson, 2002; Punch, 2006). According to Fraenkel and Wallen (2000), sample is any group on which information is obtained for study. A sample is a finite part of a statistical population whose attributes are studied to gain information about the larger population (Castillo, 2009).This study used purposive sample type to select a sample of thirty (30) form two visual art students for the study. The Researcher used purposive sample because among the accessible population they are the only group that has performed poorly and needs innovative teaching strategies to understand the concept motion. The Researcher used purposive sample because the Researcher wants to help the visual art two students to overcome their learning difficulties in motion. The Researcher chose second year students because the topic motion is located in the second year syllabus. The students also have a relevant previous knowledge in the concept after learning fundamentals and derived units.

3.4 Sampling Technique

According to Trochim (2007), sampling techniques are the methods the researchers used in drawing samples from a population usually in such a manner that the sample will facilitate determination of some hypothesis concerning the population. According to Cohen and Morison (2007), purposive sampling is the selection of sample on the basis of the judgment of the researcher. Purposive sampling relies on the judgement of the researcher when it comes to selecting the units (e.g., people, cases, organisations, events or pieces of data) that are to be studied. Patton (2002) defines purposive sample as the type in which the researcher handpicked the people to be included in the sample on the basis of their judgment.

The sampling technique used for this study is the purposive sampling because it aimed at building a sample that is satisfactory to their specific needs. The Researcher used purposive sampling to select a sample of 30 visual art 2 students for this study by including all the class. The Researcher used purposive sampling because the accessible population is the only class lacking the basic concepts in motion.

3.5 Research Instruments

A research instrument is a tool designed to measure the variable(s), characteristic(s), or information of interest, often a behavioural or psychological characteristics

(Reason & Bradbury, 2008). Research instruments are helpful tools to research study. Data collection instrumentation, such as surveys, observation, diary of records, or interview, must be identified and described. According to Pierce (2009) using previously validated collection instruments can save time and increase the study's credibility. Once the data collection procedure has been determined, a time line for completion should be established (Pierce, 2009).

Data collection is an essential component in conducting research. O'leary (2004) said that collection of credible data is a tough task and it is therefore better to use more than one method. The data collection method used should depend on the research goals, advantages and disadvantages of the methods used.In this study, document analysis was the research design used to collect data throughthe assessment of the learning outcome.

Document Analysis

Document analysis is a social research method and an important research tool in schemes of research triangulation. A document is written information that can be read about the subjects in the research work. According to Love (2003) existing documents are not only written documents, but also audio and visual recordings. A document is something that we can read and which relates to some aspect of the social world. Official documents are intended to be read as objective statements of fact but they are themselves socially produced. According to Creswell (2003), document inspection can be accessed at a time convenient to the researcher and saves the researcher time and expense of transcribing. In this study, the Researcher used document analysis wherestudents' class works ware analysed during the five lessons. The Researcher used analysis of Students' document because the Researcher wants see the progress of the students throughout the five intervention lessons. Responses to the evaluation questions in the class as well as their performance in the written assignment and class tests were also collected and analysed. .

Intervention Strategy

The Researcher designed five (80mins.) lessons using charts and diagrams to teach concept motion. During the period of intervention, five (80 minutes) lessons were taught, the first 10 minutes of each lesson was used to introduce the lesson by revising the relevant previous knowledge. (60 minutes) was used to develop the lesson by taking the students through the learning activities. The rest 10minutes was used to evaluate stated objectives of the lesson. The lesson planes are located at appendices

Lesson1was based on types of motion and the Researcher developed charts such as stone tied to thread and toy car moving in line. Lesson 2 was based on the explanation of speed, velocity, acceleration and momentum by the use of charts, diagrams and illustrations. Lesson 3 was based on distance, displacement, velocity – time graph and how to calculate their slopes using the plots and graphs. Lesson 4 was based on interpreting data graphically from diagrams. Lesson 5 was based on the conservation of momentum. Types of motion were taught by asking students to run 100m and 800m. Students also viewed the gas molecules in random motion. Oscillatory motion was discussed by tossing the pebbles tied to a rope. Fun blades were used to explain the rotational motion.

The Researcher gave distances to the students to measure and clock to read the time. The Researcher used the measurements to explain distance, displacement, speed, velocity, acceleration and momentum. The Researcher deduced linear graphs and used it to teach how to calculate total distance covered, acceleration, deceleration and momentum. The Researcher used motor bicycle, football, gun recoil and mathematical deductions to teach the Newton's laws of motion. Below are some of the charts usedby the Researcher to illustrate the key ideas in the lessons.

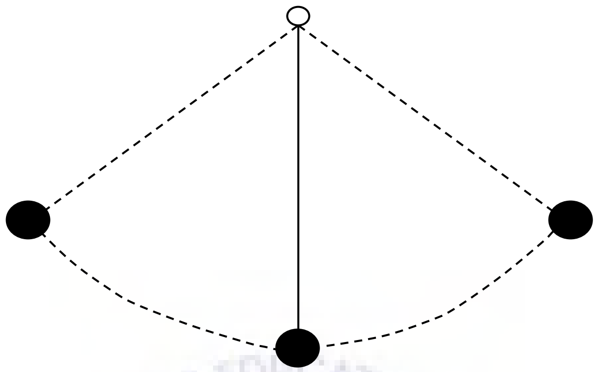

Figure 3: A pendulum bob used to teach oscillatory motion

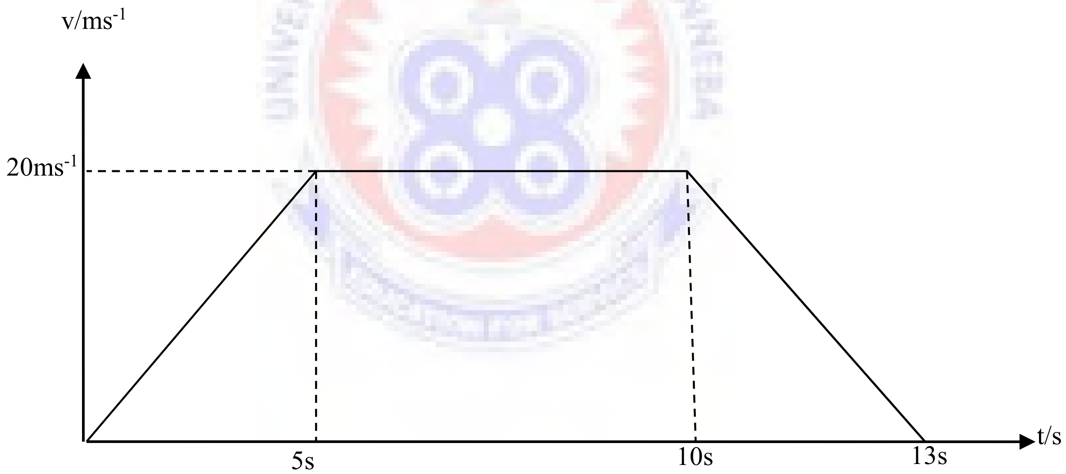

Figure 4: Velocity -Time graph used to teach acceleration and Deceleration.

Figure 5: The random motion of gas particles

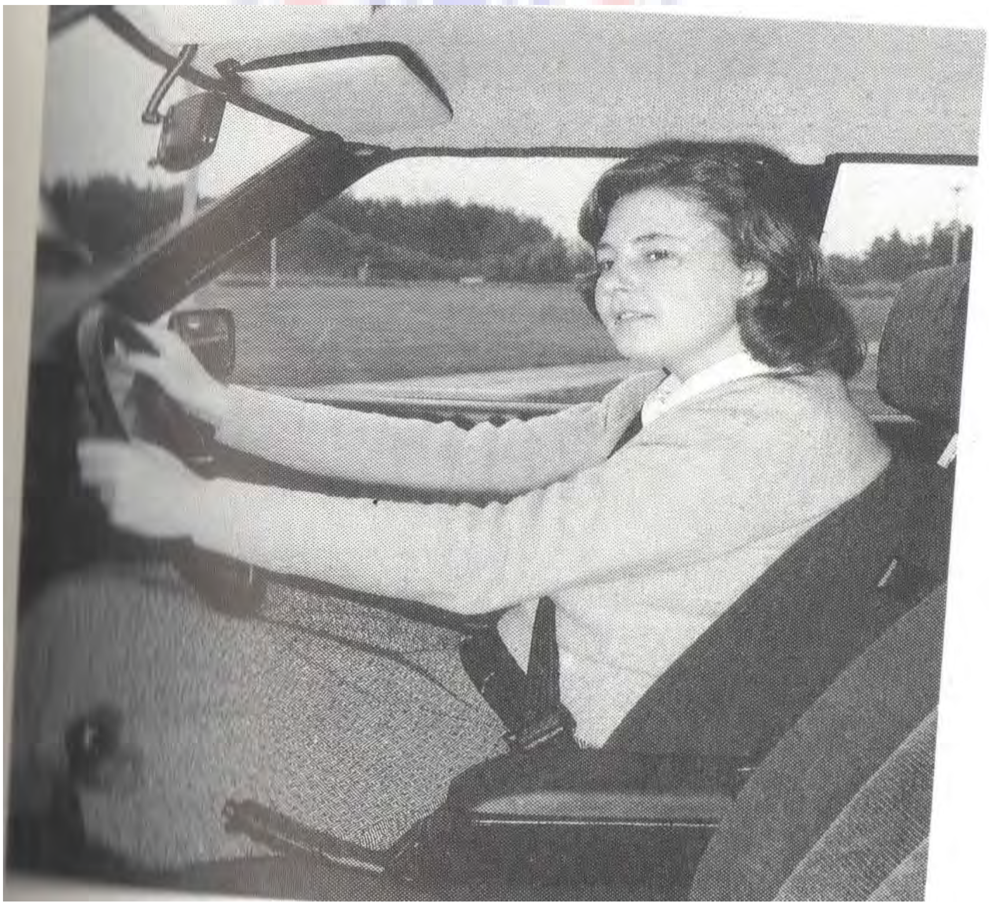

Figure 6.Fasting of seatbelt used to teach first law of Motion (Inertia).This pictures were taken from Integrated Science GAST textbook for SHS.

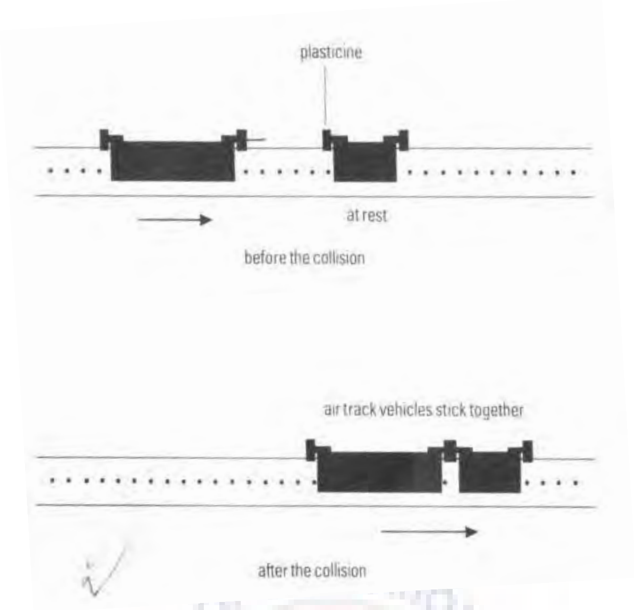

Figure 7: Collision of tracks to teach conservation of Momentum

3.6 Data Collection Procedure

According to Silverman (2000) data collection is the process of gathering and measuring information on variables of interest, in an established systematic fashion that enables one to answer stated research question hypotheses, and evaluate outcomes. Data collection tools are instruments used to collect information for performance assessments, self-evaluations, and external evaluations. In this study the Researcher designed five intervention lessons and students performance documents were used to collect data. The Researcher taught for five weeks. For each week, students were taught using charts, plot and graphs. After the lessons students' performance -was assessed through class assignments and tests. Worksheets and exercises were marked and recorded. The whole class was taken through some basic concepts in motion using charts, drawings, plots and graphs. Assessment was done at the end of each of the five intervention lessons and the students' performance was analysed lesson by lesson. The Researcher also observed and gave possible feedbacks that that students need to progress in the lessons.

3.7 Data Analysis Procedure

Data analysis is a process for obtaining raw data and converting it into information useful for decision making by users. Data is collected and analysed to answer questions, test hypothesis or disprove theories. According to Amoani (2005), data analysis has multiple approaches depending on the type of research design the researcher has chosen. In this study the Researcher used action research and the data was analysed based on the progress made by the students after every lesson. The analysis of the result was based on the progress made in each lesson based on their performance. Then the analysis was also based on the five lessons and the discussions of the findings were based on the research questions. This analysis procedure was chosen because the Researcher needs to know the effect of the intervention at every stage to plan meet the demands of students since the action research is aimed at improving the teaching and learning process in classrooms. Action research is geared towards developing a teaching and learning strategy, reports were presented on each lesson taught, the kind of activities carried out, the interactions, and the level of students' interest in the lesson was grounded in the reports.

CHAPTER FOUR

RESULTS

4.0 Overview

This chapter deals with the presentation of results and findings of the results from the five weeks teaching. The discussions were based on the teaching and learning activities that went on in the classroom, the procedures used as well as the observations made during the lessons. Data collected from students' weekly intervention exercises after lessons were analysed quantitatively and qualitatively. The students' responses were mainly presented in the form of frequencies and percentages. Descriptive analyses of results were done to provide the basis for the findings. The findings were analysed based on the research questions.

Intervention Lesson Results

To help students use plots and graphs to solve motion problems five intervention lessons were planned and delivered for four weeks with class and practical exercises using the group activity approach. At the end of each week students were made to answer few questions based on the concepts taught and the skills developed within the week and the previous weeks. The test results were given to students before the next week's lessons started. This enabled students to have enough time to do necessary correction on the areas they could not do well. Descriptive feedback in the form of written comments was provided against each wrong response presented. This helped students to know of their mistakes and how to correct them in subsequent exercises. Feedback on each exercise was discussed with students so that they could identify what went wrong and what were expected as responses to the questions asked. This strategy helped students to develop the needed skills for practical works and hence overcome the difficulty face during class work and in performing practical works. Data collected on students' output in the exercises and class test were analysed and presented as follows:

4.1Lesson Presentations

Intervention Lesson One

Topic: Motion.

In this lesson students were expected toexplain the term motion, list at least three types of motion and explain the types of motion and give one example each of the types stated. Students were asked to push a bicycle, play football, play drum and say what happened to the objects they manipulated. The types of motion was explained by doing the following activity: switching on the fan, playing the drum, swinging the thread tied to the stone, ridding the bicycle and running in the track. Random movement of gaseous particles was discussed by the use of projector. Students play drum and used their hands to feel the to and fro movement of the skin covering the drum and swinging of the pendulum bob

The students were allowed to do the activities while the Researcher moved to help correct the wrong students. The lesson was evaluated by giving tasks to students to do. The Researcher went round and observed as students performed tasks. After the period students' responses were collected and marked. Descriptive feedbacks were provided and then discussed with students. The analyses of students' responses were presented as follows;

Evaluation Question.

Question 1 Explain the term motion and state the types we have with examples.

Students' Response. The demands of this question required use of facts and skills acquired from the activities in lesson one.

Motion is the change in position or direction of a body and the types are

Circular, Rectilinear, Vibrational and Random motion.

Circular motion is the motion of a body travelling in a circular path. For example, the motion of electrons around the nucleus (2) car moving in roundabout (3) stone tied to thread and whirled about. Rectilinear motion: Is the motion of a body in a straight path. For example: running 100m race. Random motion: Is a haphazard or irregular type of motion where the body moves anyhow. E.g. the motion of gas molecules.

Rotational motion: This is the motion of in which the body rotates or spins on its own axis. E.g.: movement of fan blades. Vibration and Oscillatory motion**.** It is a term used to describe the to and fro movement of particles

Depending on the correctness of the answers to the questions, students' responses to intervention-test questions were classified as "correct" and "wrong" for each task

The responses given by the students to Question 1 were analysed and presented in Table 1 as numbers and percentages of students at each skill.

Table 1: Students' responses to evaluation questions in lesson1

Tasks	N	Correct	Wrong
Explanation	30	24(80.0)	6 (20.0)
Types	30	25(83.3)	5 (16.7)
Eamples	30	27 (90.0)	3 (10)

Note: Figures in brackets are percentages

Data from Table 1 showed that most of the responses students provided were correct As many as 24(80%) students explained the motion 'correctly. Majority thus 25(83.3%) of students were able to state the types of motion correctly.Additionally, 27(90%) of the students were able to give correct examples of the types of motion and related the examples to real life situations.

On the other hand, a few students' 6(20%) were not able to explain the term motion. Minority 5(16.7) of the students could not list the types of motion and 3(10%) of the students in class were not able give good examples of the types of motion.

Findings from lesson one.

1 About (84%) of the studentswere able toexplain the term motion correctly had the opportunity to interact and manipulate the learning materials provided.

2. Majority (83.3%) of the Students were able to explain the term motion and its types correctly and (90%) of the students state the examples correctly.

Skills Acquired: Activities in the lesson 1enabled the students to acquire the skills of observation by observing the rotational motion of fans blade, prediction of the circular motion of the earth around the sun, manipulation of the pendulum bob and running of 100 metres race, recording of the random motion of gas molecule and skills of communication in group activities and answering of questions in class.

Intervention Lesson 2

The lesson was centred on explanation of speed, displacement, speed, velocity, acceleration, momentum and group the terms into scalar and vector quantities. Students measured distance using their rules and tape measures and come out with the S.I. unit in metres. Students were group to discuss the displacement and the basic difference between the distance and the displacement. Students measured distance using their rules and tape measures and come out with the S.I. unit in metres. Students discussed the displacement and the basic difference between the distance and the displacement. Students measured masses of stone, orange, mango and a toy car by putting the respective objects on the measuring instrument. Researcher called students to repeat the activity. The Researcher used increased in velocity, decreased in velocity and uniform velocity to help students to discover acceleration, retardation, and uniform acceleration. Students used the masses and multiplied it with the respective velocities to explain the concept momentum and asked the students to derive the SI unit of momentum. Students listed distance, speed, mass and time. Students discussed the vector quantity and give the examples of Vector quantity. As a quantity that have both magnitude and the direction. Examples of vector quantity are displacement, vector, weight, acceleration and force. The lesson was evaluated by giving tasks to students to do. The Researcher went round and observed as students performed tasks. After the period students' responses were collected and marked. Descriptive feedbacks were provided and then discussed with students. The analyses of students' responses were presented as follows;

Evaluation, Questions for Lesson 2

1: Define the following terms and state their (S.I.) units.

i. Velocity ii. Speed iii. Acceleration iv. Distance v. Momentum

2: Differentiate between scalar quantity and vector quantity

Students' Responses. The demands of this questions required use of facts and skills acquired from the activities in lesson two. Velocity is the rate of change of displacement. It is measured in metres per seconds (m/s). Speed: Is the rate of change of distance. It is measured in metres per seconds (m/s).Acceleration: Is the rate of change of velocity. It is measured in metre per second squared and Distance: Is the space between two points. It is measured in metres (m) and Momentum: Is the product of mass of a body and its velocity. It is measured in metre per seconds (kgm/s). Scalar quantity is a quantity which has only magnitude but no direction while vector quantity is a quantity which has both magnitude and direction.

The responses given by the students to Question 2 were analysed and presented in Table as numbers and percentages of students at each concept

Table 2: Students responses to evaluation questions in lesson 2

Tasks	N	Correct	Wrong
Definition of terms	30	25(83.3)	5 (16.7.0)
Correct S.I. Units	30	28(93.3)	2 (6.70)
Scalars and Vectors	30	27 (90.0)	3 (10)

Note: Figures in brackets are percentages

Data from Table 2 showed that most of the responses students provided were correct As many as 25(83.3%) students defined the terms correctly. Majority thus 28(93.3%) of students were able to state the correct S.I. Units of the terms correctly .Additionally, 27(90%) of the students were able to diffentiate between scalars and vectors.

On the other hand, a few students' 5(16.7%) were not able to define the terms. Minority 2(6.7) of the students could state the S.I. Units to diffentiate and 3(10%) of the students in class were not able to differentiate between scalars and vectors.

Findings from lesson 2

1. Many students (83.3%) of the students in the class defined the terms related to motion correctly

2. 93.3% of the students were able to state the S.I. units of the terms and used it correctly in the calculations.

3. 3, About 27(90%) of students were able to differentiate between the scalar and the vector quantity.

4. Students' participation in the lesson was very high because the students were motivated by the lesson activities.

Skills Acquired: Activities in the lesson 2 enabled the students to acquire the skills of determining masses of toy cars, mangoes, stones and oranges, recording of the readings on top pan balance,prediction of the scalars and vectors quantities, .

Intervention Lesson 3

Topic: Distance, Displacement and velocity – time graph.

In this lesson the students are expected to plot velocity, displacement and distance on vertical axis and time on horizontal axis. Students were able to Label the axis correctly, choose a scale and plot values given by the Researcher. Students located the distance and the time values correctly by the help of the Researcher. Other values were given to students to plot `on displacement-time axis. Students were guided to deduce the gradient by dividing the displacement by its time to have velocity. The same procedure was followed to plot the velocity on vertical axis against time on horizontal axis. Students were guided to deduce acceleration, retardation and constant acceleration. Students used the graphs to calculate the total time spent on the journey and the total distance covered

After the lesson students' responses were collected and marked. Descriptive feedbacks were provided and then discussed with students. The analyses of students' responses were presented as follows;

Evaluation Questions on lesson 3

1.A man walked 200m form Dzodze to Penyi in 40seconds. The man returned to Dzodze in 45seconds. Calculate the total distance covered by the man. **2.** A car starts from rest and accelerates uniformly until it reaches a velocity of $40ms^{-1}$ after 5seconds. The car travels with constant velocity for 10seconds and it brought to rest in 5seconds with a uniform retardation. Draw a velocity-time graph and use it to determine. (i) Acceleration. (ii) Retardation. (iii)The distance covered after 5seconds. (iv) The total distance covered.

Students Responses

The demands of this question included: drawing and labelling the axes correctly; plotting the points correctly; drawing a straight line passing through at least three of the plotted points; determining the slope and finding the acceleration and retardation. This activity was meant to determine students' usability of the following science process skills; scaling plotting presentation, analysis and evaluation. Depending on the correctness of the answers to the questions, students' responses to the intervention-test questions were classified as "correct" and "wrong" for each skill or task

To determine 'correct' usage of plotting skills, students should be able to draw and label the axes correctly, plot the points correctly, draw a straight line passing through at least three of the plotted points. Also, for 'correct' usage of analysis skill, students should be able to determine the slope of the graph. Finally, for 'correct' usage of evaluation skills, students should be able to find the acceleration, retardation and constant velocity.

Responses were classified as wrong if respondents were not able to perform the given task in each skill. The responses given by the students to evaluation question 3 were analysed and presented in Table 3 as numbers and percentages of students at each skill.

Table3: Students' response to evaluation questions in intervention lesson 3.

Tasks	N	Correct	Incorrect
Presentation	30	27(90)	3(10)
Analysis	30	26(86.6)	4(13.4)
Evaluation	30	26(86.6)	4(13,4)

Note: Figures in brackets are percentages

Data from Table 3 showed that most of the response as many 27(90%) students exhibited 'correct' usage of the presentation skill needed whilst 26(86.8%) students exhibited 'correct' usage of both the analysis and evaluation skills required for graph works in motion. On the other hand, a few students' responses reflected wrong usage of each science process skill. Only, 3(10%) students exhibited the 'incorrect' usage of the presentation skill needed whilst 4(13.4%) students exhibited wrong usage of science skills for both analysis and evaluation of the graph wok.

Findings from lesson 3

1 Most of the students (90%) used diagrams, graphical illustrations and measurements to solve the concept on distance, displacement and velocity.

2. Majority of the Students (86.8%) were able to use the diagrams and charts to calculate the acceleration, deceleration, total distance as well as the constant acceleration.

Skills Acquired

Activities in lesson 3 enabled the students to acquire the skills of measuring of distances, plotting of values on vertical and horizontal axis, calculation based on the graph and deduction total distance, total time taken and the slope by dividing the change in vertical axis by change in horizontal axis.

Lesson objectives were achieved through the use of the skills acquired in the lesson and as well as the integration of the skills in the earlier lessons.

Intervention Lesson 4

Topic: Graphical interpretation of motion.

In this lesson the student are expected to measure distance, velocity and read time, plot a straight line graph, use the graph to deduce or calculate the slope. Tasks were given in graphic form to the students to answer. Different distances were measured and the values were recorded. A stop clock was also given to students to read the respective times.Vertical and horizontal axis was drawn and a scale was chosen for both axes. Values were plot and the students drew Sample practical questions were used to guide students deduce the column headings for the table of values. Students were then given series of practical questions and asked to construct suitable table of values for each question. Students were able to perform each of the given activities correctly. a straight line called the line of best fit was drawn passing through at least three of the coordinates. The slope was calculated by dividing change two vertical axes values over change in two horizontal axes. After the lesson students' responses were collected and marked. Descriptive feedbacks were provided and then discussed with students. The analyses of students' responses were presented as follows;

Evaluation Questions for lesson 4

Use the table below plot a graph with velocity on the vertical axis and the time on the horizontal axis. Calculate the slope and interpret significant of the slope

Table 1: Velocity and time values as expected answer to evaluation question 4

Time (t\s)	0.59	0.88	1.18	1.47	2.35
Raw velocities (m/s)	2.0	3.0	4.0	5.0	8.0
Actual velocities (m/s)	0.02	0.03	0.04	0.05	0.08

Students'Response:

The demands of this question included acquisition and the application of process skills presenting table of values; drawing and labelling the axes correctly, plotting the points correctly; drawing a straight line passing through at least three of the plotted points; determining the slope; determining the implication of the slope; finding the intercepts on both axes. Depending on the correctness of the answers to the questions, students' responses to post-test questions were classified as "correct and wrong" for each task.

The responses given by the students to evaluation questions in lesson 4 were analysed and presented in Table 4 as numbers and percentages of students at each task.

Table4: : Students' response to evaluation questions in intervention lesson 4

Task	N	Correct	Wrong
Drawing and labelling axes	30	30(100%)	0(0)
Plotting points	30	26(86.7%)	4(13.3%)
Drawing line of best fit	30	26(86.7%)	4(13.3%)
Determining slope	30	25(83.3%)	5(16.7%)
Implication of slope	30	25(83.3%)	5(16.7%)

Note: Figures in brackets are percentages

Data from Table 4 showed that most of the responses students provided reflected correct usage of skills needed for Plotting of graph All the students (100%) exhibited 'correct' usage of the process skills for drawing and labeling of axis As many 26(86.7%) students plotted the values correctly and the same students were able the draw the line of best fit. 25(83.3%) of the students, determined the slope, and gave its implication

On the other hand, a few students' 4(13.3%) were not able to plot and draw the line of best fit. Some 5(16.7%) were not able to determine and interpret the significant of the slope.

Findings from lesson 4

1 All the students (100%) were able to label the axes, as many 26(86.7%) students plotted the values and find the line of best fit correctly

2 About 25(83.3%) of the students, determined the slope, and gave its implication

Skills Acquired:

Activities in lesson 4 enabled the students to acquire the skills of: measuring of distances, recording of distances measured accurately, plotting of values on both vertical and horizontal axes.

.Students also acquired the skills of calculation of the slope from graph by dividing change in vertical axis by change in horizontal axis and skill of interpretation of the slope

Intervention Lesson Five

Topic: Laws of motion.

In this end of the lesson the students are expected to state the three laws of motion, state the law of conservation of momentum and solve problems based on the conservation of momentum. Researcher: Demonstrated the Newton's first by pushing the toy car and allow it to stop. Researcher: Used the first law to explain the term inertia by explaining the jerking forward of passengers in a moving car. Students were guided to demonstrate collision and use it to explain the momentum before collision is equal to the momentum after collision. Researcher: Used football to demonstrate the main concept in the third law of motion and the conservation of momentum formula was deduced by the students. MaUa + MbUb = MaV + MbV. Depending on the correctness of the answers to the questions, students' responses to evaluation questions were classified as "correct and wrong" for each task in the table five below.

Evaluation Question for intervention lesson 5

1: State the Newton's laws of motion. **2:** Explain the law of conservation of momentum. **3**: Why wearing of seat belts are very important to passengers in a moving car?

Students' Response: There are three laws of motion.

First Law states that moving body will continue to move or stationary object will remain at one place unless acted upon by an external force to act otherwise.

The Second Law states that the rate of change of momentum is proportional to the force applied. The Third Law states that when one object pushes against another the second object pushes back with an equal and opposite force.

Conservation of momentum states that two moving bodies, their momentum before collision will be equal to momentum after collision. The seat belts are to prevent the passengers to be firm in the seat. The responses given by the students to evaluation question 5 were analysed and presented in Table 5 as numbers and percentages of students at each task.

Table5: Students' response to evaluation questions in intervention lesson 5.

Tasks	N	Correct	Incorrect
Laws of motion	30	27(90)	3(10)

Conservation of motion	30	26(86.6%)	4(13.4)
Seat belts	30	26(86.6)	4(13,4)

Note: Figures in brackets are percentages

Data from Table 5 showed that most of the responses as many 27 (90%) students had correct response 'to laws of motion question whilst 26 (86.6.9%) students exhibited 'correct 'response to both conservation of motion and wearing of seatbelt questions. On the other hand, only, 3(10%) of the students gave wrong response to laws of motion question and 4(13.4%) of the students gave wrong response to both conservation of motion and wearing of seatbelt questions.

Findings from Lesson five

1. Students' activities, teacher's illustration and the use of toy cars enabled 27 (90%) of the students to state the laws of motion.

2. About 26 (86.6.9%) of the students gave correct response in concept of conservation of momentum and the use of seatbelt.

Skills Acquired:

Activities in lesson 5 enabled the students to acquire the skills of calculation of conservation of momentum that is equating momentum before collision to momentum after collision and drawing conclusion and inferring from the data.

4.2 Analysis of the results based on the Research Question.

Research Question 1

In what ways do plots and graphs helped students to solve problems in Integrated Science lessons?

This research question was answered by the findings 1 and 2 which indicated that more than (80%) of the students gave correct responses to the evaluation questions. This performance was because the students had opportunity to interact and manipulate the learning materials provided in the lessons. Students' interest in the lesson improved from lesson one to lesson five. As a result of these interactions through a constructivist approach, students were able to use charts, plots and graphs to solve basic calculations in motion. Students were punctual and regular in class because they were motivated by the activities in the lessons. Plots and graphs had erased the misconception that science is difficult because majority of the students in the class were able to give appropriate answers. These findings were in line with Merriam etal (2007), who stated that humans generated knowledge from the interaction between their experiences and their ideas. This theory of constructivism was one of the most important educational theories used in arousing learner's thinking and made students active, interactive and positive during the learning process.

From the observation made the use of plots and graphs enabled the students to acquire the process skills in interpreting data in graphical forms, Students developed the skills of measuring distance, reading values on clock and plotting of the values in a straight line graphs.

The use of plots and graphs coupled with diagrams and chalkboard illustrations had helped students to solve problems in Integrated Science lessons. All the students in the class were involved in the measuring, recording and plotting of the data. The students were able to name the axis, title the graph, and calculate the slope. Their contribution and interaction were highly encouraged. The use of plots and graphs were seen as a useful tool in improving students' performance and involvement in teaching and learning in activity oriented subjects like the Integrated Science. The results from this research agreed with the findings of Salinger (2003) and Duschi (2000) who examined the use of graphic organisers, like comparison charts, maps, plots and graphs said graphics enabled students to express ideas in visuals and in graphics in order to process new information hence increased students' participation in the lesson.

Research Question 2

What effects do plots and graphs have on learning the topic motion?

This research question was answered by the major finding 3 and 4 which indicated that the use of plots and graphs in teaching enabled students to use diagrams and charts to calculate the acceleration, deceleration, total distance as well as the constant acceleration. As the lessons were developed using charts, plots and graphs students were motivated to measure the distance and use the values to plot the graphs. From the research, teaching with plots and graphs gave positive effects to the students toward learning of integrated science. This was because all (100%) the students gave correct responses without wasting time during the lessons. The teaching and learning activities enabled the students to acquire the basic and integrated process skills.

The activities in the intervention lesson made the majority over (90%)of the students gave correct response to the evaluation questions. The use of plots and graphs made the learning of the concept motion to become easy and interesting. The students were motivated by the lesson activities and achieved the desired positive effect of learning was derived where students were able to comprehend. Students were able to use the key ideas in the lessons to solve basic problems that affect them daily. These findings were in consistent with the findings of Kroll and Paziotopulos (2004) who researched into the effectiveness of graphic organisers using concrete model assists study to develop and internalise their cognitive skills. The researchers concluded that graphic organisers were very effective strategy to use to learn science concepts. The results from the findings implied that plots and graphs improved the teachers' way of teaching and enabled students to express key concept easily.

Research Question 3:

What are students' feedbacks to plots and graphs test items given by the teacher?

This research question was answered by the major findings 4 and 5 which indicated that about (90%) of students gave correct response to the laws of motion and conservation of momentum. Activities, teacher's illustration and the use of toy cars enabled the students to be actively involved in the lesson. Students' performance in the evaluation exercise was very high in the concept of conservation of momentum. Prior to this research students' were very dull in class and they give wrong feedbacks. But the teaching and learning activities in the intervention lessons enabled the students to acquire skills of inferring, interpreting and communication. These scientific process skills enabled students to give a positive feedback to questions. Students used less time to classify vectors and scalars and the students react quickly to activities in class. As the lessons were being developed week by week using plots and graphs, students' interaction was increasingly improved and as a result students were able to respond to thought provoking questions quickly and correctly. Students' feedbacks were concise, precise and straight to the point. Some correct feedbacks gave by the students during the lesson were momentum is the product of mass of a body and its velocity. Small objects have small momentum. Inertia of a body depends on the mass of the body. The SI unit of the rate of change of momentum is in Newton.

Students were able to develop the formula for force equals to mass multiplies by acceleration and majority of the students plotted data they measured and recorded correctly. The positive feedbacks given to plots and graph test items implied that students learned better and can remember the facts easily when they interact and manipulate key ideas in the lessons.

These findings were in consistent with the findings of Nicoll and Macfarlane (2006) who stated that feedback practices can build self-assessment and self-regulation abilities in relation to their thinking, motivation and behaviour during learning.

This proves the fact that there was an improvement in students' feedback approaches in learning of motion and Integrated Science as a whole.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Overview

This chapter gives the summary of the findings, throwing light on key issues that emerged from the study. The chapter also draws conclusion on the outcome of the study. Some suggestions on the recommendations have been made to teachers, curriculum planners as well as other stakeholders of Education in the country.

5.1 Summary of the findings

The followings were the major findings that emerged from the study based on the effect of using of plots and graphs to teach motion in the study.

(a)Many students (83.3%) of the students in the class defined the terms related to motion correctly

(b)93.3% of the students were able to state the S.I. units of the terms and used it correctly in the calculations.

(c) 93.3% of the students were able to state the S.I. units of the terms and used it correctly in the calculations.

(d) About 27(90%) of students were able to differentiate between the scalar and the vector quantity.

(e).The students developed manipulative skills through handling of the learning materials provided in the study. All the students (100%) exhibited 'correct' usage of the process skills for drawing and labelling of axis As many 26(86.7%) students plotted the values correctly and the same students were able the draw the line of best fit. 25(83.3%) of the students, determined the slope, and gave its implication

(g).Most of the students (90%) used diagrams, graphical illustrations and measurements to solve the concept on distance, displacement and velocity.

(h) Majority of the Students (86.8%) were able to use the diagrams and charts to calculate the acceleration, deceleration, total distance as well as the constant acceleration.

(f).Students used toy cars to develop the concept of conservation of momentum.

(j). 27 (90%) students had correct response ’to Newton’s laws of motion question whilst 26 (86.6.9%) students exhibited ‘correct ‘response to both conservation of motion and wearing of seatbelt questions

(k). Students discovered the Newton’s laws of motion and how to apply it in everyday activities like running walking, movement of objects and stationary objects.

(l).About 27(90%) of students were able to differentiate between the scalar and the vector quantity.

(m).Students used the process skills to experiment and verify basic concepts in motion like conservation of momentum.

5.2 Conclusion

The study was limited to Dzodze – Penyi Senior High School in the Ketu North Districts of Ghana, some conclusion should be drawn.

(1). On the basis of the findings. It is concluded that the use of plots and graphs enabled Dzodze Penyi S.H.S Visual Arts 2 students to increase their participation in lessons, become active learners and solve mathematical problems correctly.

Plots and graphs enabled Dzodze Penyi Visual Arts 2 students to acquire process skills which helped the students to learn better. Activity based lessons helped the

Visual Art2 students to work in groups hence they learn from each other and builds student – teacher interaction in lessons.

Science teachers in Dzodze Penyi SHS are encouraged to use charts, diagrams, plots and graphs to make lessons appeal to more senses for better concept development and easy retention.

5.3. Recommendations

Based on the findings of the study, the following recommendations are given;

(1). The use of graphics such as charts, diagrams, illustrations, plots and graphs has the potential to help Dzodze Penyi Visual Art 2 students to visualise science concepts and develop them better. Teachers may therefore, use graphics to elaborate their teaching.

(2). Science lessons should be made interactive and activity based. This will encourage Dzodze Penyi Visual Art 2 students' participation in the development of the lessons.

(3). Teachers in Dzodze Penyi Senior High School should use familiar and useful illustrations, charts, diagrams, plots and graphs that have direct link with the student's background to teach. The charts, diagrams, plots and graphs should be presented in systematic and logical way to bring out the meaning of the lessons.

(4). Teachers in Dzodze Senior High School should learn how to manage good and bad feedbacks in lesson delivery. This will encouraged the students to think critically and give good feedbacks which can serve as salient points in lessons.

(5) After using the charts, diagrams, plots and graphs to teach students in Dzodze Penyi Senior High Visual Art 2, it came to light that the students' acquisition of science process skills was improved tremendously. It is therefore recommended to the curriculum planners and the ministry of science, and technology to include a lot of graphics in planning the syllabus for Dzodze Penyi SHS students.

(6).Teachers in Dzodze Penyi SHS should illustrate complex mathematical formula in charts and daily live activities in the school environment for the students. This will enable student the broad picture of the mathematical concept and develop it gradually.

5.4 Suggestion for further studies

This study was undertaken to unearth the effects of using plots and graphs in teaching the topic motion. Teacher – Students' interactions, interactions among students and the use of plots and graphs were observed for a periods of five weeks. The following suggestions are made for further studies:

(1). Further studies could be conducted in other science subject areas like physics, biology, agriculture and chemistry to see the effects of plots and graphs to learning those subjects.

(2). Study could also be done to find out the effect using plots and graphs works better on boys or girls.

(3). Further research should consider the effect of using plots and graphs in teaching the concept heat energy in Senior High Schools.

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APPENDICES

LESSON ONE : APPENDIX A

TOPIC: Motion

FORM: Visual Art 2

DURATION: 80 minutes.

RPK: Students have been ridding bicycle to school.

OBJECTIVES: By the end of the lesson, the student will be able to:

i. Explain the term motion

ii. List at least three types of motion.

iii. Explain the types of motion and give an example of it.

TEACHING AND LEARNING MATERIALS

Charts and diagrams on the different types of motion, stone tied to a thread, drum and a standing fan.

TEACHER - LEARNER ACTIVITIES

INTRODUCTION

Teacher asks the students to describe how ridding of bicycle is done.

ACTIVITY ONE

Assist students to brainstorm to explain the meaning of the term motion.

ACTIVITY TWO

Help students to identify the different types of motion by using the diagrams.

ACTIVITY THREE

Let students discuss the types of motion mentioned.

ACTIVITY FOUR

Help students to discuss types of the motion

ACTIVITY FIVE

Guide students to use the knowledge gained to solve basic problems

CORE POINTS

Motion is the change in position or direction of a body. e.g. movement of a body from point A to B.

TYPES OF MOTION

The types of motion are Circular motion, Rectilinear motion, Rotational motion, Vibrational motion and Random motion

1. Circular motion. This is the motion of the body travelling in a circular path e.g. motion of the electron about the nucleus. E.g. a stone tied to a string and whirled round, a motorist negotiating.

2. Rectilinear Motion. This is the type of motion, which takes place along a straight line. It is also known as translational or linear motion. e.g. running 100m race

3. Rotational Motion. This is the type of motion in which an object rotates or spins on its own axis. e.g. the motion of a wind mill, rotation of the earth about its axis causing day and night.

4. Random Motion. This is a haphazard or irregular type of motion. e.g. the motion of a drunken man staggering about, the movement of gas molecule.

5. Vibrational / Oscillatory Motion. This is the to and fro motion of a particle e.g. motion of a simple pendulum, movement of a piston in an automobile, the motion of a car wiper, the motion of the balance wheel of a watch

APPLICATION

State two ways in which the concept motion would be helpful to industries.

EVALUATION

1. Explain the term motion.
2. State the types of motion.

Explain the following terms and give one example each of it.

1. Circular motion, rectilinear motion, rotational motion, random motionand oscillatory motion.

CONCLUSION

The teacher Summarise the core points orally and give written assignment for marking.

APPENDIX B

LESSON TWO:

TOPIC: Explanation of Speed, distance, displacement, velocity, acceleration, and momentum.

FORM : Visual Art 2

DURATION: 80 minutes.

RPK: Students have been taking part in the schools' athletic competition.

OBJECTIVES: By the end of the lesson, the student will be able to:

i. Explain the term distance, displacement, speed, velocity, acceleration and momentum

ii. Group the terms into scalars and vectors

TEACHING AND LEARNING MATERIALS

Tape measure, charts, graphics on speeding and accelerating.

TEACHER - LEARNER ACTIVITIES

INTRODUCTION

Ask students to explain the difference between 100m and 200m events in athletics.

ACTIVITY ONE

Assist students to explain the term distance and displacement. Help students to measure distances and come out with the S.I. unit.

ACTIVITY TWO

Guide students to explain the term speed and velocity using the chart.

ACTIVITY THREE

Lead students to discuss acceleration and momentum. Demonstrate the concept of acceleration by varying the velocity of two bodies.

ACTIVITY FOUR

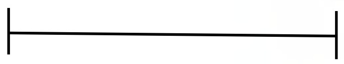
Guide students to measure some masses of objects in the class and measure the same velocities of objects. Help students to multiply the mass with the velocity.

ACTIVITY FIVE

Assist students to brainstorm to differentiate between scalar and vector quantity.

CORE POINTS

Distance is the space between two points. For example



The S.I. unit of distance is in metres.

Displacement

Is the position of a point of a point relative to its origin. Or Is a distance move is a specify direction. It is measured in metres.

Speed is the rate of change of distance. It is measured in ms^{-1}

□□□□□□□□□□□□□□□□□

Acceleration is the rate of change of velocity measured in ms^{-2}.

Deceleration is negative acceleration and it is also called retardation.

Uniform acceleration occurs when the rate of change of velocity is constant.

□−□□

Momentum is the product of mass of a body and its velocity. MV is measured in $kgms^{-1}$

Scalar Quantity is any quantity which has only magnitude but no direction e.g. mass, distance, speed, time and temperature.

Vector quantity is any quantity which has both magnitude and directions e.g. displacement, velocity, acceleration, weight, magnetic field, moment.

APPLICATION

Send students to the field to demonstrating constant speed, acceleration, uniform acceleration and retardation.

EVALUATION

Define the terms velocity, speed, distance and momentum.

Differentiate between scalar and a vector quantity.

State the S.I. unit of the following

i. distance

ii. displacement

iii. momentum

iv. acceleration

CONCLUSION

The teacher reviews the salient points orally and gives assignment.

APPENDIX C

LESSON THREE:

TOPIC: Distance, displacement and velocity - time graph.

FORM: Visual Art 2

DURATION: 80 minutes.

RPK: Student learnt how plot co-ordinates on x and y plane.

OBJECTIVES: By the end of the lesson, the student will be able to:

i. Plot a distance, displacement and velocity time graph

ii. Use the graph to calculate total distance, total time and the acceleration.

TEACHING AND LEARNING MATERIALS

Tape measure, black board ruler, chalkboard illustrations.

TEACHER - LEARNER ACTIVITIES

INTRODUCTION

Ask students to plot some values on the x,y plane e.g. (3,2) (1,1)

ACTIVITY ONE

Link the plotting of the (x,y) values to the distance, time value and use of values from basic distance - time motion.

Help students to locate the axis on their graph sheet by and time to x-axis.

ACTIVITY TWO

Guide students locate distances covered with respect to time spent e.g. 5m in 25 (5m 5s) and (10m 2s).

ACTIVITY THREE

Guide students to use the graphing concept to plot displacement time graph.

Help students to plot some displacement and their respective times.

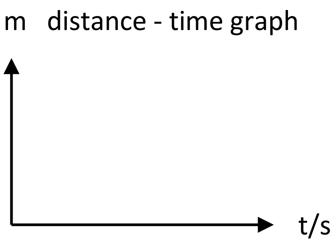
ACTIVITY FOUR

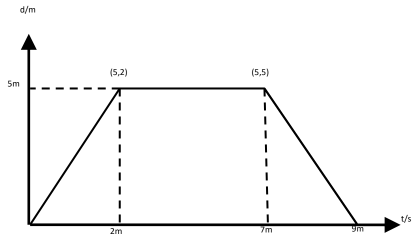
Assist students to plot some velocities with their respective time.

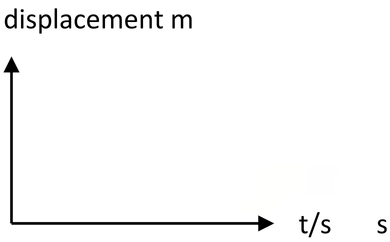
Help the students to the graph to calculate the acceleration.

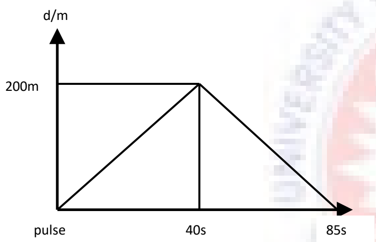
CORE POINTS

Distance-time graph is a pictorial or diagrammatical representation of distance covered within a specified time.







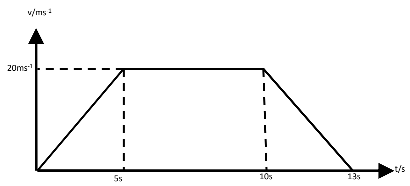


Total time used for the journey

40s + 45s = 85s

Total distance = 200m + 200m

= 400m



□−□□

20−05

a $=4ms^{-2}$

EVALUATION

A man walk from Dzodze to Penyi 200m in 40s. He returns to Dzodze in 45s. Calculate the total distance.

A man starts from rest and runs with a velocity of $20ms^{-1}$ in 5s. He continued with the same velocity for 5s and come to rest in 3s.

A car starts from rest and accelerated uniformly until it reaches a velocity of $40ms^{-1}$ after 5s. It travels with constant velocity for 10s and is brought to rest in 5s with a uniform retardation. Draw a velocity time graph and use it to determine

i. acceleration

ii. retardation

iii. the distance covered after 5s

iv. the total distance covered.

CONCLUSION

Summarise the core points, ask questions and call students to answer and give assignment.

APPENDIX D

LESSON FOUR:

TOPIC: Interpreting motion data graphically

FORM : Visual Art 2

DURATION: 80 minutes.

RPK: Students have learnt how to draw velocity - time graph.

OBJECTIVES: By the end of the lesson, the student will be able to:

i. Measure distance, velocity and time.

ii. Use the values got them measurement to plot straight line graphs.

iii. Calculate the slope of the graph

TEACHING AND LEARNING MATERIALS

Tape measure, metre rule, chalkboard, illustration.

TEACHER - LEARNER ACTIVITIES

INTRODUCTION

Ask students to measure distances.

ACTIVITY ONE

Guide students to read and record data from the drawings.

ACTIVITY TWO

Guide students to draw the graph by choosing the scale.

ACTIVITY THREE

Help students to plot the values measured.

ACTIVITY FOUR

Guide students to find the line of best fit.

ACTIVITY FIVE

Assist students to calculate slope for the graph and interpret what the slope represents.

CORE POINTS

Scale is the method of representing data measured on grid paper. It is the process of giving equal interval to the data representation on vertical and the horizontal axis.

The steps involve in plotting of values on graph sheet are:

(1) choose a scale

(2) label the axis

(3) Locate the values on their respective line. Line of best fit is a line drawn through at least three points on the graph sheet.

Slope or Gradient is a concept where the vertical axis will be divided with the horizontal

Δ▯Δ▯= ▯▯−1▯

APPLICATION

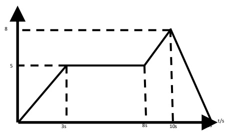
Guide students to measure and use the data to plot new graph.

EVALUATION

1. What is a scale?

2. What is a line of best fit?

3. Use the diagram below to findi. total distance, ii. Accelerationiii. deceleration



CONCLUSION

Summarise the salient points and give assignment

APPENDIX E

LESSON FIVE:

TOPIC: Motion

FORM : Visual Art 2

DURATION: 80 minutes.

RPK: Students can explain motion.

OBJECTIVES

By the end of the lesson, the student will be able to:

i. State the three laws of motion

ii. State the conservation of momentum

iii. Solve problems based on the conservation of momentum.

TEACHING AND LEARNING MATERIALS

Ball, toy cars, toy guns and chalkboard illustration, seat belt.

TEACHER - LEARNER ACTIVITIES

INTRODUCTION

Ask pupils to state objects to be in motion.

ACTIVITY ONE

Lead students to push the care and stop it and link it to the first law. Guide students to discover the term inertia and its practical example.

ACTIVITY TWO

Lead students to discuss the second law. Students contribute and ask questions. Guide students to develop the mathematical representation of the concept.

.ACTIVITY THREE

Use the toy cars to establish concept of conservation of momentum. Help students solve problems involving conservation of momentum.

ACTIVITY FOUR

Use the ball to demonstrate the meaning of the Newton's third law of motion to the students.

Help students brainstorm to get some practical examples of Newton's third law of motion.

CORE POINTS

LAWS OF MOTION. There are three laws of motion called Newton's laws of motion.

1ST LAW states that moving body will continue to move in stationary body or remain at one place unless there is force acting upon it.Inertia is the tendency of the body to remain at rest or continue its motion in straight line unless it is acted upon by an external force.

Practical examples of inertia

a. Falling forward when the car stops suddenly

b. A cyclist does not come to rest immediately after he stops paddling.

Newton's Second law states that the rate of change of momentum of an object is directly proportional to the force acting on it and takes place in the direction of the force.

□□−□□□

□□−□□□ but K = 1

□□−□□□

□(□−□)□

F = ma

Conservation of momentum

Momentum before collision is equal to momentum after collision

MaUa + MbUb = MaVa + MbVb

Solution

Momentum before collision is equal to momentum after collision

$MaUa + MbUb = (Ma + Mb)V$

$2kg \times 3ms^{-1} + 3kg \times 4ms^{-1} = (2kg + 3kg)V$

$6kgms^{-1} + 12kgms^{-1} = (5kg)V$

$18kgms^{-1} = (5kg)V$

$18kgms^{-1} 5$

$18ms^{-1} 5$

$35ms^{-1}$

Newton's Third Law of Motion states that when one object pushes against another, the second object pushes back with an equal and opposite force e.g. recoils of gun.

Parachutes and rocket engines apply the third law.

Seat belts are made to protect the passengers during accidents from falling out of the care through the windscreen.

APPLICATION

Give some scenario or problems to students that will demand students understanding of the concept and how they can use the new idea to solve situations in their daily lives.

EVALUATION

1. Define inertia and state two practical examples of inertia.

2. State the conservation of momentum.

3 Find the velocity of the two cars after they have collided if car A has 2kg and $3ms^{-1}$ and car B has 3kg and $4ms^{-1}$

4 State Newton's third law of motion and list the practical examples of the third law.

5 Why are the seat belts necessary in protecting divers during accidents?

6 State Newton's law of motion and list two examples of the Newton's third law of motion.

CONCLUSION

Summarise the core points and give written assignment for marking.