UNIVERSITY OF EDUCATION, WINNEBA

EFFECTS OF TLMs AND LEARNER-CENTRED APPROACH IN PHYSICS LESSONS IN SELECTED COLLEGES OF EDUCATION

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A THESIS IN THE DEPARTMENT OF SCIENCE EDUCATION, FACULTY OF SCIENCE EDUCATION, SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES, IN THE UNIVERSITY OF EDUCATION, WINNEBA, IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF THE DEGREE OF MASTER OF PHILOSOPHY IN SCIENCE EDUCATION OF THE UNIVERSTY OF EDUCATION, WINNEBA

NOVEMBER, 2016

DECLARATION

STUDENT'S DECLARATION

I, **SIMONABEDI OPARE**, 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.

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ABEDI OPARE SIMON DATE

SUPERVISOR'S DECLARATION

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

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PROF. K. D. TAALE DATE

(PRINCIPAL SUPERVISOR)

………………………………….. …………………………..

DR. ANTWI DATE

(CO-SUPERVISOR)

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DEDICATION

This research work is dedicated to my lovely wife, FaustinaKoomson and my childrenAwuramaNhyiraOparebiaAbedi and NkunyimObrempongOpare for their strong support and encouragements through this programme.

TABLE OF CONTENTS

Contents

Page

LIST OF TABLES

TABLE PAGE

ABSTRACT

This research was conducted to investigate the effects of using teaching learning materials (TLMs) and learner-centred approach on performance in physics in Colleges of Education in Ghana. The target population comprised 15 science and mathematics colleges of education in Ghana. The accessible population consisted of 3 colleges out of the 15 science and mathematics colleges of education consistingof second year science students and their physics tutors in Central and Western Regions of Ghana. Purposive sampling technique was used to select 90 science students and 3 physics tutors for the study. A combination of qualitative and quantitative (mixed method) data collecting instruments including questionnaire, observational checklist and interview schedules were used in the study. The data analysis involved the use of SPSS to determine frequency and percentages of responses. A practical activity/experiment was carried out to find how effective that approach will have on students' performance. The findings indicated that physics tutors in colleges of educations were found of using lecture method to teach physics without involving their students in lesson mostly practical work and this might have contributed to the poor performance of science students in physics lessons. It was found out that most of the science colleges lacked adequate TLMs and resources for practical lessons. The study found out that using TLMs and learner-centred approach to teach physics helped and encouraged students to participate more actively in lessons, which resulted in an improved student's performance in class. The study recommended that physics tutors in science colleges of education in Ghana to use TLMs and learner-centred approach in their teachings, which the study showed to be very effective in improving the performance of students in physics lessons.

CHAPTER ONE

INTRODUCTION

1.0 Overview

This is the introductory chapter of the research report. It deals with the background to the study, statement of the problem, purpose of the study, research questions, and significance of the study.Delimitation and limitation are the final part of the chapter.

1.1 Background to the Study

According to Arhin and Asimah (2004), science is a way of learning which involves firsthand experience, inquiry, problem solving, and interpretation of data and communication of findings. It is easy to observe that science has become part of our lives. This is because we apply science in everything that we do. Science helps us to understand nature. For example, natural phenomenon like earthquake cannot be predicted but can be explained. Science plays an important role in this technological and computer age. It forms the base of many subject areas. Science is divided into two categories, which are natural science and the applied science. The applied science deals with the practical use of the knowledge acquired in natural science. Some of the applied sciences are Engineering, Medicine, Pharmacy, Agriculture, Electronics, I.C.T and Material Science. Natural science is a branch of science that deals with the physical world. The subjects that make up natural science are chemistry, physics, biology, geology, astronomy and meteorology. The knowledge acquired from these subjects of science helps in the development of skills and enhances knowledge thereby leading to improved creativity which in a way tends to bring new ideas, artifacts and inventions into existence.

It is not possible these days to do many things without making use of scientific devices and principles. Transport, industrial processes, entertainments, everyday objects such as pens, electric lights, watches, etc., all use applied sciences. This makes the study of science very important. By the time students leave school they should be familiar with the scientific principles, know how the mind of the scientist works, understand the world in which science has so much influence and plays such a vital role, and in which one must work.

Science has helped to develop the individual and the economy as a whole as it is postulated by many scholars that science education over the years has been a tool that services societal demands and expectation. Science has kept faith with the rapid changes in technology. As such the subject should be taught and learnt from the basic levels to the higher levels and needs to be taught with requisite materials and pedagogical skills. It is a fact that one of the importance of good education is to enable individuals contribute their quota to the development of society and also seek improvements in their daily lives. Through science the world has become a global village. That is, Technology has also made our world smaller (Brown, 2014). It has completely changed the way we communicate with each other and how we organize work and also brought effective transportation system. Therefore, it has become easy for one to move from one community to another or cross from one continent to another.

We have arrived at a point in our history when there must be a major increase in the capability of all persons to cope with the scientific and technological culture that is shaping their lives and the lives of their children. We live in a world dominated by science and technology and to be illiterate in science is terrifying and not accepted.

This is true because no country achieves an industrialized status without paying attention to science and technology. Society, its culture and its value system have a strong influence on scientific development. Science and technology do not exist independently of society (Cheng, 2016). In fact, society has more of an impact of science than any other factor. Every society in history has developed science based on its needs, interests, hopes and dreams. These include the areas of military equipment, space travel, ocean exploration, modern medical technology, fertilizers, pesticides and bio-fuel(Cheng, 2016).

It is a plan for every government especially those in the developing countries to make science and technology education a major objective of their national education policy and make every effort to achieve it. Energy forms the basis of all human activities. Without energy, modern life will cease to exist. In the past, the only source of energy to man to run his obsolete machines was the power generated from steam (vapour from boiling water). Today as technology advances, more energy sources have been made available to humans and this include solar energy, wind energy, hydroelectric power, geothermal energy and biomass/biogas energy. Modern life requires general scientific literacy for every Ghanaian citizen (Teaching Syllabus for Integrated Science, 2010), a requirement that will create a scientific culture in line with the country's strategic program of achieving scientific and technological literacy within the shortest possible time. Scientific culture should therefore become common property of every citizen in a country because it is the antithesis to superstition and the catalyst that will help us toward faster development.

In an effort to address such peculiar needs in order to improve upon the quality of science and technology in Ghana, the government in his national educational document; Vision 2020 has laid much emphasis on science education. One of the basic objectives of Vision 2020 is to develop adequate science and technology capabilities and to provide infrastructure which will enable industries and other sectors of the economy to provide the basic needs of the society (Anamuah-Mensah, 1998). This means that learning of science should start from the primary schools.

The focus of the study of science is to understand the natural world. According to Pies (2010), Science is the pursuit of knowledge and understanding of the natural and social world following a systematic methodology based on evidence. Science knowledge is acquired through observation, experimentation and evaluation of information. The information is gained in relation with other established bodies of knowledge, gathering and recording of knowledge to find answers to the questions and challenges that life poses every day.

Owolabi (2004) defined science as an integral part of human society. Its impact is felt in every sphere of human life, so much that it is intricately linked with a nation's development. Science as a field of study has done a lot for mankind. For instance, life has been made a lot easier for humans as a result of the advancements in science. Through science, humans have been able to better understand their environment and this has enabled them to manipulate the conditions of their environment to suit their own benefit. Science has also made it possible for human to acquire their desired needs easily. It has reduced human needs to the barest minimum. Ogunleye (2000)observed that science is a dynamic human activity concerned with understanding the workings of the world. This understanding helps humans to know more about the universe. Without the applications of science, it would have been impossible for humans to explore the other planets of the universe. Also, the awareness of the existence, of other planets would not have been realized without science

At this level in education it is necessary to go more deeply into the various branches of science for a more thorough understanding of each. The scientific knowledge available is so vast that an attempt to understand every bit of it is impossible. It is reasonable however to learn a little of some part. This may be done by studying physics and practicing the techniques used by a physicist. According to About.com, physics is the study of matter, energy and the way they interact. Physics is one of the key disciplines of science. The boundary between physics and the other key disciplines are not rigid or fixed. For example, medical physics obviously involves human biology as well as physics. Understanding natural phenomena has always been a central aim of physics. Physics deals with energy and matter and their interactions. It is sometimes referred to as the science of measurement and its knowledge has contributed greatly to the production of instruments and devices of tremendous benefits to the human race. The knowledge of Physics plays a very significant role in the development of any nation. The importance of Physics cannot be over emphasized as it forms the basis for technological advancement of any nation. Physics plays a vital role in the development of any society(Sani, 2012). Empirical studies from the field of Physics Education Research (PER) have outlined essential suggestions about physics curriculum which are generally accepted and believed to widen the knowledge and increase the horizon of understanding of physics by learners (Buabeng, Ossei-Anto&Ampiah, 2014). Among the essential suggestions are: (1) the method of teaching physics should be guided by learner-centred instead of the traditional lecture method used in teaching the subject. This was recommended due to the fact that learning efficiency and effectiveness take place during explanation, experimentation and discussion; (2) there should be interaction between the physics teacher and the students. In this case, it is believed that if genuine and helpful interaction exists between the teacher and students and among students, the students will be able to inform teachers what they find difficult in physics thereby reducing the difficulties they (students) encounter (Adeyemo, 2010). These features are essential because it is believed that if they are dully and critically followed and applied in any given situation and at any given time, teachers will be able to make physics easy to be comprehended by learners (Adeyemo, 2010).

The desire to pursue physics at higher levels (beyond secondary education) is influenced by the success rate and foundation a student receives in physics at the high school. A study by Buabeng and Ntow (2010) revealed a wide range of reasons which accounted for students' negative response to physics in Ghana. Prominent among these factors were teacher factor, poor performance, perceived difficulty nature of physics and unknown career opportunities in the subject. Most of the students reported that there is a reduced interest in the subject at the Senior High School (SHS) level because the subject was poorly presented to them. Interestingly, physics teachers who participated in the study admitted that poor tuition is one of the many reasons accounting for the low interest level among students (Buabeng&Ntow, 2010). According to Aina and Akintude (2013) students usually performed very poorly in physics in all level of education. Trainee teachers in colleges of education studying physics are also facing the same difficulties. Many researchers have equally supported the view that students performed poorly in physics (Akanbi, 2003; Aiyelabegan, 2003).

One major reason for this poor performance might not be separated from the abstract nature of the course as observed by Adeyemo (2010). The teaching of physics in schools, mostly in colleges of education in Ghana has not been encouraging at all due to how it is being taught in class and the abstract nature of the subject.

Among the comment often generally made is that students do not understand what they learn in class. Some factors responsible for student's general poor performance in science, technology and mathematics are poor laboratory facilities/equipments (TLMs), inability of the Physics teachers to put across ideas clearly to the students and inadequate number of learning facilities in schools as against consistent increase in the number of students.

Learning Physics as a science subject is practical oriented and therefore the best method for teaching it should be a learner-centred approach which students are responsible for the learning making use of teaching learning materials. This suggests that the mastery of Physics concepts cannot be fully achieved without the use of teaching learning materials. The teaching of Physics without learning materials will certainly result to poor performance in the course. Jegede, Okota and Eniayeju (2010) stressed that a professionally qualified science teacher no matter how well trained would be unable to put his ideas into practice if the school setting lacks the equipment and materials necessary for him or her to translate his competence into reality.

It is the teachers' responsibility to be creative and innovative in selecting and using instructional technique(s) and materials that will motivate students to learn, be appropriate to variety of learning styles and be usable within the context of the learning environment (Erinosho, 2008). The physics syllabus embodies a wide range of activities such as projects, experiment, demonstrations and scientific enquiry skill (CRDD, 2008). All these objectives are achieved by the teacher through giving innovative and appropriate instructions to the physics students. The physics teacher is therefore required to design teaching sequences with appropriate teaching pedagogies that has the potential to develop students' interest in the subject and their abilities to properly respond to situations they may encounter in their world of life that their knowledge in physics may be of benefit. There is a wide range of instructional techniques for science teaching and learning. It includes teacher-centred and learner-centred approach. The learner-centred approach involves students in lessons to make learning meaningful and help students to share ideas together.

The hallmark of good teaching is the quality learning among students. Miller (2012) state that "learners are treated as co-creators in the learning process, as individuals with ideas and issues that deserve attention and consideration". Underlying the process of science teaching is the fundamental assumptions about the uniqueness of learners, differences in individual's patterns of development and the active nature of student learning. These assumptions influence instructional procedure and outcomes, selection of instructional materials and methods of assessment. Effective teaching of physics requires sound pedagogical skills, knowledge of the subject matter and classroom practices to support the learning process among all categories of students. Some of the ways by which a teacher can induce quality learning in the physics classroom are: making physics learning active and student-centred and the use of teaching learning materials (TLMs) to teach physics. These two strategies used for teaching physics will involve students in practical lessons to find solutions for themselves which will help in the improvement in student's performance.

Teaching and Learning Materials in Science may be defined as the instructional materials, equipment or devices which help a teacher in effective realization of his teaching objectively by calling upon the auditory and visual senses of his students.

Instructional materials or teaching learning materials have been defined by various authors. Isola, (2010) refers to them as objects or devices, which help the teacher to make a lesson much clearer to the learner. Instructional materials are also described as concrete or physical objects which provide sound, visual or both to the sense organs during teaching (Agina-Obu, 2005). There are many teachers who try to do good lessons and use some Teaching Learning Materials (TLMs) but they use few types of TLMs and some do not know how to use these items well. Teaching learning materials are in various classes, such as audio or aural, visual or audio-visual. Thus, audio instructional materials refer to those devices that make use of the sense of hearing only, like radio, audio tape recording, and television. Visual instructional materials on the other hand, are those devices that appeal to the sense of sight only such as the chalkboard, chart, slide, thermometer, spring balance, etc. An audio-visual instructional material however, is a combination of devices which appeal to the sense of both hearing and seeing such as television, motion picture and the computer. Among the instructional materials the classroom teacher uses, the visuals out-number the combination of the audio and audio-visual. This suggests that the mastery of physics concepts cannot be fully achieved without the use of teaching learning materials.

The use of learner-centred approach for teaching makes learners contribute to the lesson by sharing ideas on what is being learnt or taught. Students are not considered to be empty vessels; they come with their own perceptual frameworks. Focus is not just on what is taught but how effective learning should be promoted. Student learning becomes the main preoccupation of the teacher (not his/her performance as a teacher or a new number of facts to be transmitted to the students). It is recognized that students learn in different ways and have different learning styles. Most people learn best with hands-on activities, but some gain a lot more from it than others. Students really increase their learning potential when they are given the opportunity to do something by themselves especially in a science classroom there should be plenty of opportunities to learn by doing. Personalized/individualized responses are encouraged and this helps to foster creativity in students. Learning is recognized as an active dynamic process in which connections are constantly changing and their structure is continually reformatted. Such connections are fostered through dialogue between teacher and students, and students with peers. This makes 'Learner-centred learning' a highly social enterprise that requires the constant development of human relationship and communication.

All countries in sub-Saharan Africa place emphasis on learner-centred education. So active learning approaches characterise their science, mathematics and technology curricula. Hence learner-centred education, participatory teaching, inquiry-based approaches, problem-solving and critical thinking are some of the key phrases that feature prominently in curriculum policy documents of these African countries (Ottevanger, Akker,&Feiter, 2007). This is in line with current trends in science education worldwide that learning is not a passive activity but an activity in which pupils actively construct knowledge through interaction with their existing knowledge, and ideas provided by materials, other pupils and the teacher (Ottevanger et al, 2007). However reports from these countries, including Ghana, consistently describe the pedagogy that actually dominates the classroom as: “largely traditional, teacher-centred and content-driven, with notes taking and sometimes practical, especially in preparation for the practical examination at the end of Senior High School; and whole class teaching at all levels, in spite of the curriculum advising otherwise” (Ottevanger et al, 2007).

The term, "learner-centered" describes a concept and a practice in which students and teachers learn from one another. It proposes a global shift away from instruction that is fundamentally teacher-centered, at times glibly termed “sage on the stage,” focusing instead on learning outcomes (Anderson, Balsamo, Bucher, Carnicke, Chrystal,Fliegel, Garner and Hollins, 2006). It is not intended to diminish the importance of the instructional side of the classroom experience. Instead, instruction is broadened to include other activities that produce desirable learning outcomes. Learner- centered teaching places the emphasis on the person who is doing the learning (Weimer, 2002). Learner-centred teachers articulate what we expect our students to learn, design educational experiences to advance their learning, and provide opportunities for them to demonstrate their success in achieving those expectations. A learner-centred environment grows out of curricular decisions and in-class strategies which encourage students' interaction with the content, with one another and the teacher, and with the learning process. It encourages students' reflection, dialogue, and engagement, and requires a reliable assessment of their content mastery.

Through learner-centred, students construct their own meaning by talking, doing, listening, writing, reading, and reflecting on content, ideas, issues and concerns. The emergence of learner-centred instruction arises from the quest to have all students achieve more success in their educational enterprise. Interestingly some students and faculty have resisted the change. There are students who thrive in teacher-centered instruction and many claim to prefer the experience. Weimer (2002) suggests this is because it makes less demands upon them, until the evening before an exam, whereas learner-centred pedagogy requires a more active role in the classroom experience. The use of learner-centred approach in combination with TLMs in learning physics will help students do inquiries and cooperate learning, active learning, experiment and finds answers for themselves which improves their learning performance.

The prime objective of teaching science is to develop such skills in a student which helps him/her to know the facts, principles of science, its applications, identify the objects and to make concepts clear and understanding. The need of the study is to find out the extent of the effects of teaching learning materials and learner-centred instructional approach on teaching physics lessons in colleges of education in Ghana. Teachers are only the powerful agents for improving the quality of the students.

1.2 Statement of the problem

Physics considered to be one of the difficult subjects in science is seen as abstract and also taught in abstract. Understanding the natural phenomena has always been a central aim of physics. Physics is considered to be a practical oriented subject in science. Tutors in colleges of education teaching physics always complain of how students fail in physics during their conference marking after every semester examination. From the Chief Examiner's report for second year end-of-second semester examination (2009), the candidate's general performance was below 50%, candidate performed very poorly in all sections of the paper. These are some of the comments made in the summary of candidates' weakness from the Chief Examiner's report;

1. Candidates' performance seems to suggest that they had not been doing physics practical.
2. Candidates' mathematics was weak, and hence they could not solve simple problems associated with the experiment.

3. Questions on heat were not popular with candidates and the few who attempted fared very poorly.

Since the inception of the colleges of education in Ghana, the teaching and learning of science has faced many problems resulting in the poor performance of students in the subject nationwide in both internal and external examinations. Students in the colleges of education offering science and studying physics perform poorly in physics during end of semester examinations.

The problem around this study is that most of the teachers teaching science, mostly physics in colleges of education use lecture method to teach and do not involve students in learner-centred teaching and practical lessons with the use of appropriate teaching learning materials. According to Chief Examiner's Report (2006) for integrated science methodology, candidates did not have in-depth understanding of the use of equipment and materials in the laboratories to solve scientific problems.

This study therefore aims to find out how the use of teaching learning materials and learner-centerd instructional approach will be effective on students' performance in physics lessons in colleges of education in Ghana.

1.3 Purpose of the study

Students in colleges of education face problems in studying science especially the physics component which is a crucial factor for improving science education in Ghana. The performance of students in physics determines the corresponding attitude they have towards the subject due to the way they are being taught.

The purpose of this study was to find out the effects of using TLMs and learner-centred approach to improve students' performance in physics in colleges of education in Ghana.

1.4 Objectives

The objectives of this study were to:

1. Determine whether students of colleges of education offering science are encouraged in co-operative learning and inquiry.
2. Establish whether the use of learner-centred instructional strategy will suit and encourage students' participation in physics lessons.
3. Determine whether physics tutors use TLMs effectively in student's physics lessons in colleges of education.
4. Find out whether the use of learner-centred approach and TLMs will improve students' performance in physics in colleges of education in Ghana.

1.5 Research questions

The following research questions guided the study.

1. What extent do co-operative learning and inquiry encourage performance ofstudents in science?
2. What is the impact of learner-centred instructional strategy on student's participation in physics lessons in colleges of education?
3. What extent do physics teachers use TLMs in teaching physics in the colleges of education?

4. To what extent will the use of learner-centred instructional approach and TLMs help in the improvement of students' performance in physics in colleges of education in Ghana?

1.6 Significance of the study

This study suggests a way for teaching and learning of physics in colleges of education in Ghana. The result of this study will be available to science tutors teaching physics in colleges of education, especially those in the schools involved in the study.

This study hopes to bring improvement in the instructional strategies used by science tutors teaching physics in colleges of education. It is hoped that the findings of the study may encourage physics teachers to use teaching and learning materials and learner-centred approach to teach physics which is likely to develop and improve student's performance. It is also hoped that teachers teaching science especially physics in colleges of education will involve students in practical lessons with the use of teaching and learning materials for student's active participation in lessons for effective performance.

It is envisaged that the findings and recommendations would become a valuable resource material for physics teachers, curriculum designers and researchers. Besides, researchers who would want to carry out further studies on this topic would utilize the findings and recommendations of this study for their own studies.

1.7 Scope of the study

This study covers science students studying physics in colleges of education in Ghana. The study talks about the effective use of TLMs and learner-centred instructional approach to teach physics. The study used only the second year students studying physics in three selected science colleges of education in Ghana.

1.8 Delimitation

There are thirty eight (38) colleges of education in Ghana. The researcher selected three of them offering science as special course and studying physics as one of their major subjects in the Western and Central Region of Ghana for the research. The unavailability of funds and time constraint prevented the researcher from carrying out the study throughout the thirty eight colleges.

1.9 Limitation

The study was limited to only three science colleges of education out of the fifteen science colleges in Ghana namely Komenda College, Foso College and SefwiWiawso in the Central and Western Regions.It is the researchers hope that the findings of this research could beapplied to all the fifteen science colleges of education in Ghana.

1.10 Research Paradigm

The study leaned more on the interpretative paradigm. It used some of the related methods and techniques such as questionnaire for data collection and involved documented analysis and interview. The learner-cented approach makes the learner active participant in the learning process. Active learning approach aims to stimulate and shape a combination of cognitive, motivational and emotion self-regulatory process that characterize how people focus their attention, direct their effort and manage their emotions during learning (Kozlowski, Toney, Mullins, Weissbein, Brown & Bell 2001).

The active learning approach is distinct in two fundamental respects. First, active learning approach provides individuals with significant control over their learning, whereas passive approaches to learning have the instructional system.

Second, the active learning approach is grounded in the constructivist vision of learning, which argues that learning is an inductive process in which the individuals explore and experiment with the task to infer the rules, principles and strategies for effective performance (Mayer, 2004).

Constructivists assert that learners construct meaning uniquely based on personal interactions with society, individuals and objects; constructivists-inspired learning environments often provide resources for learners to manage their own learning through exploration with materials, hypothesis formation and students' relevant feedback.

An interpretive methodology incorporating a constructivist perspective was used in this study. The method employed here was similar to that used by Constructivism as a Paradigm for Teaching and Learning. Data was generated from the relevant literature which led to the formation of tentative assertions which guided the questionnaire.

1.12 Definition of Terms

TLMs – Teaching Learning Materials

CRDD - Curriculum Research and Development Division

Instructional Approach – is an overall view or philosophy that a person has of instruction

Inductive – characterize by the inference of general laws from particular instances.

Cognitive – a psychological process involved in acquisition and understanding of knowledge, formation of beliefs and attitudes, and decision making and problem solving.

Constructivists – a theory based on observation and scientific study about how people learn. It says people construct their own understanding and knowledge of the world through experiencing things.

Learner-centred – method of teaching that shift the focus of instruction from the teacher to the student.

Effects – a change which is a result or consequence of an action or other cause.

Pedagogy - the method and practice of teaching, especially as an academic subject or theoretical concept.

1.13 Organization of the research

This research is organized into five chapters. The first chapter is the introduction which contains the background to the study, statement of the problem, the purpose of the study, research objectives, the research questions and the significance of the study. The delimitation and limitation of the study as well as the research paradigms and the definition of terms as they are used in the study have also been captured in the chapter.

Chapter two contains the review of literature related to the study while chapter three provides the details of the methodology that was used for this study. Chapter three also describes the various areas of the study such as the research design, sample and sampling technique, data collection procedures and the data analysis procedures.

In the fourth chapter, there is a presentation of the gathered data, analysis of the data and a discussion of the results. The last chapter which is the chapter five covers a summary of the result findings, conclusion, recommendations and suggestions made from the evidence gathered via this project.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

In this chapter, the related literature review will involve the discussion of materials related to the various aspect of this study. It is relating to the ongoing dialogue in the literature on the use of teaching learning materials (TLMs) and learner-centred approach in teaching physics and its effects on students' performance in colleges of education in Ghana. This was viewed under the following topics: Encouraging co-operative learning among students; encouraging students inquiry; students involvement in the lesson; what is learner-centred instructional strategy?; encouraging student participation in learner-centred instructions; meaning of TLMs and their effective use; instructional techniques in science classroom; utilization of TLMs in the teaching of physics; demands on teacher's pedagogical skills; and theoretical framework.

2.1 Encouraging Co-operative Learning Among Students

Recently, encouraging students to work or co-operate with each other in constructing their own understanding has been a highly valued principle of effective teaching in science (Cimer, 2007). The popularity of co-operative learning rose rapidly during the early 1980s as the use of individualistic 'mastery learning' declined (Cimer, 2007). Educators realised that the motivational and mediating impact of peer-peer interactions was the missing part of the individualised mastery instruction.

Therefore, educators viewed co-operative learning to be a more efficient way of meeting the range of needs of students in a science classroom. Theoretical foundations of co-operative learning have been strongly affected by Vygotsky's ideas about learning. According to Cimer, (2007) indicates that learners do not construct knowledge in isolation but through social interaction with their peers and thus, the interactions among learners affect each other's learning. This implies that working with other students is a critical component of the process of knowledge construction. Therefore, Social constructivists view learning as a social process. It does not take place only within an individual, nor is it a passive development of behaviors that are shaped by external forces. Meaningful learning occurs when individuals are engaged in social activities (Kim, 2001). Consequently, the main idea of learning in science has been a social constructivist perspective. Social constructivist views put a great emphasis on language and communication. Intersubjectivity is a shared understanding among individuals whose interaction is based on common interests and assumptions that form the ground for their communication (Kim, 2001). Communications and interactions entail socially agreed-upon ideas of the world and the social patterns and rules of language use. Knowledge is derived from interactions between people and their environments and resides within cultures (Kim, 2001). This suggests that students need to communicate with each other and their teacher in order to articulate their prior knowledge about a concept and their explorations made in an investigation, to elucidate their thinking and to correct their misconceptions. Students can meet these aims in co-operative learning groups. Co-operative learning groups promote community aspects of the classroom and the role of discussion with peers in helping students to learn science. This offers many benefits for students for their learning and growth. For example, peer-peer discussions in co-operative learning groups can promote meaningful learning by helping learners to help each other to incorporate new experiences and information into their existing cognitive structures in a non-arbitrary and non-verbatim way (Cimer, 2007). Therefore, it is believed that co-operative learning can foster the development of deep understanding (Joyce, Weil & Calhoun, 2000).

In co-operative learning groups, learners can moderate each other's learning in ways that are distinctively different from the teacher's way of teaching (Jones & Carter, 1998). As students are at similar developmental levels, they can sometimes be more effective than adults in helping individuals to construct meaning. In other words, since they generally use similar words and terms while speaking, peers can understand each other's talk and explanations more easily. For example, a peer may help a confused student by rewording the teacher's explanation.

Co-operative learning improves students' thinking and helps them construct their own understanding of science content by strengthening and extending their knowledge of the topic. The sharing of ideas allows students to explore, refine, and question new ideas (Chin & Brown 2000), which brings about learner-centred approach, providing an environment free of some of the social pressures of teaching science with the teacher. Students may have the chance to reveal their existing ideas and explain them, ask questions to challenge each other's ideas and provide interactions for creating relations among concepts. Such discussions may create a pool of students' ideas and productive arguments over disagreements. As a result, the exchange of ideas among students in small groups may bring about the development of difficult conceptions. In addition, they can provide cognitive conflict that can promote reconstruction of new knowledge.

Furthermore, effective co-operative learning groups can provide an opportunity for students to give and receive feedback from other students regarding their understanding (Joyce et al, 2000). Consequently, students can learn from each other and develop a shared understanding of the topics they are learning. Sharing different experiences promote a group's problem solving and creativity skills among learner (Cimer, 2007). Moreover, seeing that others' views can enrich and help their thinking, this encourages students to tolerate alternative points of view from each other. In addition, members in group benefit from each other's existing competencies and skills. For example, a student who already knows how to handle a microscope, a balance or other science laboratory tools can help other members' knowledge construction and skill development.

Overall, because of these benefits, numerous studies in very diverse school settings and across a wide range of content areas have reported that co-operative learning can positively increase students' achievement and develop their skills and attitudes towards the subject being studied (Cimer, 2007). For example, Cimer (2007) reported that students with poor achievement taught by using a group investigation method throughout a year-long course in social studies achieved average gains nearly two and a half times those of the lower achievement students taught by the whole-class method. In fact they scored more highly than the higher achieving students taught with whole-class method. These can be explained by the fact that the shared responsibility and interaction produce more positive feelings toward tasks and others, generate better inter-group relationships and result in better self-images for students (Joyce, Calhoun & Hopkins, 2000).

However, co-operative learning requires teachers to carefully plan tasks and to closely monitor students' access to power and authority within the group, which can vary according to a myriad of factors including gender, race, personality and socio-economic status. Without careful planning and monitoring, despite its wide advantages, co-operative learning can be of little help to the learner, as it can isolate and restrict a group member's access to the materials, ideas and peer assistance. As a result of this there is the need encouraging students' attitudes in the teaching and learning of physics.

2.1.1 Students' Attitudes in Physics

Physics is considered as the most problematic area within the realm of science, and it traditionally attracts fewer students than chemistry and biology. Physics is perceived as a difficult course for students from secondary school to university and also for adults in graduate education. In developed countries, it has been found that goals of science are never fully realised, that student success in physics is lower than chemistry and biology, that students do not like science lectures and that most have no preference for science, particularly physics (Mattern&Schau, 2002; Rivard& Straw, 2000). It is well known that both high school and college students find physics difficult, and as a scientific discipline it is avoided because of its negative reputation. Over the years, students' achievement in physics has prompted educational researchers to continuously make relentless efforts at identifying mitigating factors that might account for the observed poor performance. Some research studies suggest that factors inside and outside the classroom affect students' achievement and interest. Orleans (2007) asserts that the key factor in what comes out at the end of schooling is what goes on in the classroom. Wambugu and Changeiywo, (2008) stated that teaching methods are crucial factors that affect the academic achievement of students, and no matter how well-developed and comprehensive a curriculum is, its success is dependent on the quality of the teachers implementing it. Some research has revealed the reason associated with students' attitudes towards physics courses and methods of teaching (Craker, 2006; Normah&Salleh, 2006). They have highlighted that they take pleasure in physics course if the students know how to plan and implement the strategies of solution to the questions through teaching methods. Normah and Salleh (2006) indicated that students' attitude and interests could play a substantial role among pupils studying science. Several studies have revealed that students' positive attitudes towards science highly correlate with their achievement in science.

Achievement, motivation and interest of students are influenced by their positive and negative attitudes. In classroom, it is found that students who had positive attitudes towards science had positive attitudes towards their science teacher, science curriculum and science-classroom climate. Students' attitude toward science is more likely to influence the success in science courses than success in influencing attitude.

Students' attitudes towards physics should consider their attitudes towards the learning environment. Research has demonstrated that, the attitudes toward science change with exposure to science, but that the direction of change may be related to the quality of that exposure, the learning environment, and teaching method (Craker, 2006). Results were obtained in the study conducted by Mattern and Schau (2002) after exposing students to a self-learning device.

If students have negative attitudes towards science, they also do not like physics courses and physics teachers. Based on this premise, numerous studies have been conducted to determine the factors that affect the students' attitudes in science. From these studies, some basic factors can be listed, including: teaching-learning approaches, the type of science courses taken, methods of studying, motivation, attitudes, science teachers and their attitudes, self-adequacy, cognitive styles of students, influence of peers, social implications of science and achievement (Craker, 2006; Normah&Salleh, 2006). Studies have revealed the influence of methods of instruction on students' attitudes towards science. These studies on attitudes generally explore how attitudes influence success. Attitudes, whether positive or negative, affect learning in science mostly physics aspect. However, it is well known that a negative attitude towards a certain subject makes learning or future-learning difficult. Therefore, helping students develop positive attitudes towards physics courses should be considered an important step in science education.

Moreover, research has shown that conventional teaching and traditional teaching methods have negative effects on the ability of learning physics for the majority of the students (Erdemir, 2004). Conclusions from research show that in order to increase the level of attitude and success in physics education, new teaching methods and technology need to be implemented into physics education (Adesoji, 2008; Gonen&Basaran, 2008). In this regard, learner-centred approach is best on attitudes and achievement of students in a developmental science course; the result was that attitude becomes more positive after instruction. Therefore, it is reasonable to claim that the usage of learner-centred strategies is more useful than conventional methods for physics learning. Learner-centred approach is a primary objective in learning science with the use of TLMs. By involving students in lesson, a student needs to be active participant in the lesson, make decisions and solve problems using appropriate strategies. Students' success in achieving their goals will encourage them to develop positive attitudes towards physics and other problem-solving activities.

Several teaching methods can be used in physics teaching. Learner-centred is one approach. Learner-centred involves students actively in the lesson. Students participate in lessons to share ideas and find solutions to problems with the help of teaching learning materials. Learner-centred is also an action which covers a wide range of mental abilities by learners finding solutions to problem and sharing ideas. Students should realize what and why they are doing, and know the strengths of these strategies, in order to understand the strategies completely and be able to select appropriate ones (Erol, Selcuk&Calıskan, 2006). Therefore, the investigation of students' attitudes, behaviours, problem solving, knowledge and skills becomes important with the use of learner-centred approach with TLMs. There is the need to encourage student's inquiry in the learning of physics.

2.1.2 Encouraging Students' Enquiry

In recent years, there has been a growing movement to integrate inquiry into science education (Trowbridge, Bybee & Powell, 2000; Deboer, 2002). The importance of inquiry grew from Dewey's ideas. Cimer, (2007) argues that citizens in a democratic society should be enquirers with regard to the nature of their physical and social environments and be active participants in the construction of society. They should ask questions and have the resources to find answers to these questions, independent of external authority.

Since there is a shared, collaborative aspect to life in a democratic society, students also need to develop a capacity for communal enquiry into the nature of the world. Therefore, formal education needs to give students the skills and dispositions to formulate questions that are personally significant and meaningful to them.

Trowbridge et al, (2000) define enquiry as 'the process of defining and investigating problems, formulating hypotheses, designing experiments, gathering data and drawing conclusions about problems'. A potential result in inquiry-based teaching enables students to gain insights into the nature of scientific inquiry (Amos &Boohan, 2002) and understand how and why to apply the scientific method at the same time as they come to understand the subject. Having science process skills acquired, means preparing future scientists and having scientific literacy acquired, explicitly enabling students to use science information in daily life (Ergul, Simsekli, Calis, Ozdilek, Gocmencelebi&Sanli, 2011).They can also understand what science is like and what scientists do. The use of teaching learning materials (TLMs) encourages or brings about inquiry.

Engaging in inquiry can also help students develop a wide range of skills, such as psychomotor and academic or intellectual skills. Psychomotor skills involve doing something physical, like gathering and setting up apparatus, making observations and measurements, recording data and drawing graphs while academic or intellectual skills include analysing data, making comparisons, evaluating results, preparing reports and communicating results to the others or the teachers. Furthermore, students' attitudes and dispositions such as curiosity, inquisitiveness, and independence of mind, freedom from external authority, and a personal search for meaning about the world can also improve.

According to Khan and Iqbal (2011), an inquiry-based science lesson is a student-centered method of teaching which provides students with the opportunity to ask questions and follow instructions to arrive at new knowledge, and provide students in a science class the opportunity to think and reason critically. Khan and Iqbal (2011) revealed that there was a statistical significant difference in the mean performance of the students who were taught some scientific skills in Biology with the inquiry laboratory teaching method and students who were taught the same scientific skills with the traditional teaching method in the posttest. This shows that the acquisition and performance of students in the science process skills were enhanced through inquiry-based science teaching which is a learner-centred based. The use of an activity-based lesson such as teaching Physics by inquiry will help improve the performance of students in Physics (McBride, Bhatti, Hannan, & Feinberg 2004), thereby making them to have interest and understand physics concepts easily. Making inquiry in physics also involves the use of TLMs to make findings. Students making hands-on activities and inquiry science teaching help improve their attitudes towards the study of science.

Therefore, it would appear that inquiry-based learning can prepare students to be lifetime learners rather than classroom-only learners (Trowbridge et al., 2000; Deboer, 2002). In order to implement inquiry-based teaching successfully in science, teachers should fulfill some important conditions (Trowbridge et al., 2000: 210). First of all, teachers should allow students to have 'freedom' to seek out desired information. Students must be allowed to try out their ideas and invent ways of accounting for what they see and can ask their own questions (Joyce et al., 2000a; Trowbridge et al., 2000; Amos, 2002). Furthermore, teachers should encourage students to discuss and talk to one another about the topic being taught during the class (Trowbridge et al., 2000). Hipkins, Bolstad, Baker, Jones, Barker, Bell, Coll, Cooper, Forret, France, Haigh, Harlow and Taylor (2002) argue that in any format, discussion can provide opportunities for students to clarify and share their own understandings, test out their understandings, ask questions and challenge the views of other students and the teacher, and use the new ideas with confidence. Moreover, Trowbridge et al (2000) suggest that teachers' asking and 'telling' should be at a minimum level because classrooms where the teacher is always the questioner and students the respondents, do not easily promote student inquiry and participation. Instead, they encourage student passivity and dependence. Therefore, teachers need to use less question-answer dialogue but organise more class time for student questions, student individual and group reports and whole class and small group discussions.

However, there are issues in this approach which need to be addressed: classroom management, time, teacher doubts about students' ability to originate a feasible research project and distrust that students will follow through to the end of the investigation (Cimer, 2007). Also teachers who have low levels of understanding of subject matter knowledge may not wish their students to ask questions because they may not know how to respond, and this becomes difficult for these teachers to move away from a position of student control through questions.

The second condition for implementing inquiry-based teaching is that teachers should provide a 'responsive environment', which can be a classroom, a laboratory or the outdoors on a field trip (Cimer, 2007). It is not enough to supply only a sterile classroom or lecture hall for students. Instead students need a range of resources including books, a laboratory with enough equipment/materials, library, and computers (Joyce et al., 2000a; Trowbridge et al., 2000). For example, using ICT facilities makes student inquiry easier, quicker and a richer process than doing the equivalent using a textbook (Boohan, 2002). If students are guided in their search of knowledge from the internet, they can obtain important gains from it in their inquiry process.

Through using the Internet, students can explore information in a variety of ways and access the updated scientific information about a particular topic that has not been covered in textbooks (Boohan, 2002). This can enable students to ask their own questions to professional scientists and to use the same or slightly modified data and tools used by professional scientists around the world. The third condition suggested by Cimer, (2007) is that teachers should provide 'focus', which means that inquiry is a purposeful activity, a search for particular meaning in some event, object or condition that raises questions in the inquirer's mind. It is stimulated by confrontation with a problem. Knowledge is generated from inquiry (Joyce et al., 2000b).

The final condition that teachers should fulfill is to provide 'low pressure'. This indicates that students will gain their reinforcements directly from the success of their own ideas in adding meaning to the environment (Cimer, 2007). In order to provide 'low pressure' to students, teachers should be positive and flexible to encourage students further (Joyce et al., 2000b).

Furthermore, there is also need for a positive and supportive learning environment in order to foster student inquiry and to encourage students to ask their own questions (Amos, 2002). In non-threatening and trusting classroom environments, students can show their willingness to seek understanding and express their curiosity. On the contrary, in such classrooms where the conditions are not supportive and encouraging, students may not put forward questions. The teachers' role in encouraging student inquiry is often dependent on the creation of a co-operative social environment, where students learn how best to negotiate and solve conflicts necessary for problem solving (Joyce et al., 2000a). In addition, teachers should also 'guide students in methods of data collection and analysis, help them frame testable hypotheses, and decide what would constitute a reasonable test of a hypothesis'.

They should ask open-ended, higher level questions to their students to encourage them to find out answers to the problems at hand and reveal their own ideas and thoughts (Glenn, 2001; Amos, 2002). To summarise, inquiry-based teaching is helpful for students to construct their own meaning and understanding and to gain some important skills that they can use throughout their lives. Therefore, teachers should encourage inquiry-based learning among students and create opportunities for them to conduct inquiry about a particular problem or issue.

2.1.3 Students' Involvement in a Lesson

Recently, there has been much emphasis on participatory lesson activities because there is a general agreement that effective learning requires students to be active in the learning process (Abell& Lederman, 2007). Active teaching and learning involves the use of strategies which maximize opportunities for interaction between teachers and students, and amongst the students themselves, as well as between students and materials and the topic at hand. In addition, researchers believe that the more students are involved in the learning process, the more they learn the topic and likely to develop a sense of ownership in relation to the learning (Deboer, 2002; Trowbridge, Bybee & Powell, 2004). Ideas can only be formed in students' minds by their own active efforts and cannot be created by another person. This suggests that students are not simply passive recipients of information from the teacher, computer, textbooks, or any other source of information during the learning process as advocated by traditional teaching and learning methods which are teacher–centred. Instead they have to grapple with an idea in their own minds until it becomes meaningful to them.

Active learning approaches can empower students to make good decisions and take an active role in their own learning, increase their motivation to learn, foster and value the diverse voices of students (Deboer, 2002). Passive learning is a traditional instructional style that involves teachers lecturing and students taking notes. The primary activity of passive learning is passive listening. Critics of passive listening say that students are just retaining information until the next test, instead of beyond the classroom. Different methods and strategies have been suggested for involving students in lessons and engaging them in active learning (Deboer, 2002; Trowbridge et al., 2004). One of these methods, which are embraced in this study, is the learner-centred approach with the use of TLMs (it talks much on learner-centred with activity base). These approaches advocate the constructivist classroom practices and help students make deeper, more meaningful knowledge constructions in the classroom and their environments.

2.2 Learner-Centred Instructional Strategy

The term, "learner-centered" describes a concept and a practice in which students and teachers learn from one another (Anderson, Balsamo, Bucher, Carnicke, Chrystal, Fliegel, Garner & Hollins, 2006). It proposes a global shift away from instruction that is fundamentally teacher-centered, at times glibly termed “sage on the stage,” focusing instead on learning outcomes. It is not intended to diminish the importance of the instructional side of the classroom experience. Instead, instruction is broadened to include other activities that produce desirable learning outcomes. Learner-centered teachers articulate what we expect our students to learn, design educational experiences to advance their learning, and provide opportunities for them to demonstrate their success in achieving those expectations (Anderson et al, 2006).

A learner-centered environment grows out of curricular decisions and in-class strategies which encourage students' interaction with the content, with one another and the teacher, and with the learning process. It encourages students' reflection, dialogue, and engagement, and requires a reliable assessment of their content mastery. Conventional wisdom has been that if teachers teach well and offer insightful, clear, rigorous, challenging, and even enjoyable lectures, the students will learn. Learner-centered pedagogy questions this assumption, given differences in how students learn. The emergence of learner-centered instruction arises from the quest to have all students achieve more success in their educational enterprise (Anderson et al, 2006).

Learner-centred brings attention to students. Focusing student attention on the material to be learned is an important factor in effective learning (Joyce et al., 2000b). There is a school of thought which proposes that teaching learning materials should match individual learning styles, i.e. visual, auditory and kinesthetic (Joyce et al., 2000a, 2000b). Moreover, students remember best those ideas or concepts that are presented in a way to relate their sensory channels, however, resources are limited and students must often learn by themselves with textbooks, videos, and online multimedia. Furthermore, after leaving formal education, students must be able to construct their own knowledge and build on it with different types of learning resources (Muller, 2008).

The use of audio-visual aids in education has been found to be an effective way of communicating ideas and concepts to students (Ouellette, 2004). Literature has also established that audio-visual-aided instruction has greatly improved the performance of students in physics especially those with special needs and slow learners abilities (Osokoya, 2007).For example, models help students make sense of the world; we conceptualize students' understanding of models as a component or subset of their understanding of the nature of science (Gobert&Pallant, 2004)

Interestingly some students and teachers have resisted the change. There are students who thrive in teacher-centered instruction and many claim to prefer the experience. Some teachers find it quite complex to use teaching learning materials to complement the traditional lecture method while others perceive the use of it as waste of time. Others either feel these materials are inappropriate for instruction or use them poorly (Quarcoo-Nelson, Buabeng & Osafo, 2011).This makes less demand upon them, whereas learner-centered pedagogy requires a more active role in the classroom experience. For teachers, it can mean a shift of some level of responsibility to students, which may feel like a loss of control.

There is evidence to suggest, for example, that learner-centered pedagogy does not raise the desirability of an institution in terms of admission applications. Zemsky, Robert, Gregory, Wegner and William (2005) argue that students are not always motivated to maximize their learning; students choose schools on the basis of the "competitive advantage" they expect the school to provide after graduation. The fact that students bring other motivations to bear on their choice of educational environments presents other complications for a pedagogic strategy based on student-learning preferences.

To be effective, a change toward learner-centered teaching may require a re-centering of assessment practices to include more and different evaluations of the learning experience. In many cases, this may mean substantial revision of mid-semester and end of semester class evaluations to include questions regarding the learning experience. Through considerable study and often engaging debate, teachers have to embrace learner-centered pedagogic practices.

2.2.1 Encouraging Student Participation in Learner-Centred Instructions

Recently, there has been much emphasis on participatory classroom activities because there is a general agreement that effective learning requires students to be active in the learning process (Stepanek, 2000). In addition, researchers believe that the more students are involved in the learning process, the more they learn the topic (Trowbridge et al., 2000; Deboer, 2002). Taras (2002) suggests that learner-centred learning has, in theory, promoted and brought about greater student participation and involvement. Therefore, for students to be at the centre of the learning and teaching process, their needs and requirements must be at the heart of this process.

The learner-centred approach (involving activity, practical work or experiment) is one of such methods considered for the teaching and learning of science at the colleges of education level in Ghana. The learner-centred of teaching places the student at the centre of the teaching and learning process where the student is made to interact with TLMs to discover scientific concepts, facts, or principles with or without any teacher support but teacher being a facilitator. The materials used by the students in learner-centred lessons are either provided by the teacher or the students (Ministry of Education, Youth, and Sports [MOEYS], 2006). In a learner-centred lesson, the teacher introduces the topic and distributes the TLMs as well as the instructions for the activity/experiment for the students to carry out the activity on their own to discover a new scientific concept or idea. The teacher then acts as a co-learner or a facilitator showing interest in the students' activity (Khan &Iqbal, 2011).

The learner-centred due to its nature has been given several names one of which is Inquiry Science. McBride et al, (2004) found out that during the training of teachers to teach Science (Physics) by inquiry, the instructors for the program acted as co-learners by monitoring the learners involved in the activities and where necessary gave direction to them. This is a characteristic feature of learner-centred of science teaching where the students are placed at the center of the teaching and learning process to form scientific concepts with little or no interference of the science teacher.

From the American Association of the Advancement of Science (AAAS) (1990), cited in Adu-Gyamfi (2013), students existing ideas prior to the teaching and learning of any new knowledge lay the foundation for the construction of the new knowledge. The students learn the new knowledge by creating a linkage between the new and the existing knowledge or restructuring the new and the existing knowledge. The learner-centred is said to make use of the linkage and reconstruction of the new and existing knowledge as expressed by the AAAS (1990) and hence, one of the reasons for the use of learner-centred at the colleges of education level is that it takes advantage of students' making use of TLMs during physics lesson and sharing ideas among peers through inquiry. The learner-centred approach of science teaching gives students sufficient time to carry out the activity in discovering the new knowledge and this is appreciated by the AAAS (1990). Hence, AAAS (1990) asserted that the teaching and learning of science should be carried out in such a way that students will have enough time to explore, observe, collect, sort, test ideas, measure, record, draw, interview, survey, compute, and to skillfully handle scientific implements. This enhances students' retention of scientific concepts, and hence, the students' performance on such concepts.

Regardless of instructional format, the foremost recommendation is that teachers must continue to seek means to remain engaged with their students. This has always been important to classroom instruction, but in these times of pedagogical change, it is even more relevant. The means are well traveled and proven to be substantial to the learning experience of students. The following is a distillation from a recent workshop offered by University of South Carolina's (USC's) Center for Excellence in Teaching, "Engaging Students in a Learner-Centered Classroom", which is available on-line in both PowerPoint and video format.

Know your students; depending on the size of the class, this could mean knowing their names, majors, and backgrounds. But foremost, it means that you know a student is in your class, and hopefully more. Most students relish this recognition and it empowers their engagement to learn.

Style of instruction; teachers are encouraged to keep the class interactive. One aspect of learner–centered instruction is providing students the opportunity to teach their peers. It also serves to further student responsibility or ownership of class objectives, including the learning process. The time-honored Socratic method of teaching continues to be a vital means of engaging students.

Make the course relevant;many students have clear educational and/or career goals or may simply ask, "Why learn this?" We are encouraged to relate the class to historical or societal issues where appropriate, or students' future goals. The learning goals of the class need to be perceived as relevant to the student's aspirations or experience. In some classes, this can mean the use of current topics or case studies extended to problem-based learning.

Active teaching; this is as important as ever, including the role of humor and even story telling. Teachers are encouraged to share their passion regarding the subject and to feel free to get personal by offering their own anecdotes.

The use of eye contact, variation in voice volume and tone, provocative questions, and the long entrusted pause to wait for answers continue to be important methods for drawing students into the learning process. In large classrooms, one can leave the podium and walk the aisles to further involve students in the new learning mode. Once they have it, let them explore. This is when we need to give full rein.

Meaning can only be formed in students' minds by their own active efforts (Sunal, 2004) and cannot be created by someone else for students. They have to wrestle with an idea in their own minds until it becomes meaningful to them. Joyce et al (2000a) state that the opportunity to exchange views and share personal experiences produces the 'cognitive conflict' that is fundamental to intellectual development. In order to foster cognitive conflict, students need opportunities to pose questions about science, to work with others, to conduct investigations, present and defend their ideas, solutions, and findings, and assess their own and other students' reasoning (Cimer, 2007). These all imply that they need to participate in learning process mostly with the use of teaching learning materials (TLMs).

Active learning techniques can empower students to make good decisions and take an active role in their own learning, increase their motivation to learn, foster and value the diverse voices of students and reduce disciplinary problems (Deboer, 2002). Researchers believe that this is a result of a sense of ownership and personal involvement that active learning creates. In active learning contexts, students see their work as important because they feel important and their ideas and findings are valued. Amos (2002) argues that students' active participation also requires a positive, supportive learning environment in which they feel free to ask their own questions, express their ideas and thoughts and receive support and encouragement. When students realise that their ideas and thoughts are valued and treated with respect by the group members, when they actively involve themselves in group activities, they feel more confidence, and thus, participate more in the activities. Instructors engage students in active, collaborative discovery, which increases students' responsibility for learning and gives students the ability to shape their learning experience (Brown 2008).

Many different methods and strategies have been suggested for involving students in lessons and engaging them in active learning (Trowbridge et al., 2000; Deboer, 2002). However, in order for any method to be successful, effective lesson planning is essential (Cimer, 2007). A lesson plan requires teacher to be clear about the sequence of the activities in the lessons, the purpose and goals of the lessons. The planning process involves clarification of the roles of the teacher and students. Thus, it makes easier for students to follow the teacher's teaching learning material and encourages them to participate more in the lesson and take responsibility for their own learning (Cimer, 2007). Planning well for a lesson brings positive effect on student's learning. Moreover, according to the above, teachers should allow some flexibility in lesson planning in order to encourage students to participate more in the lessons. It is important to be sensitive to the mood of the class and if something is not going well abandon it and move on or change tactics completely. Otherwise, a rigid lesson plan potentially hinders rather than helps the teaching-learning process, since it could prevent students from being involved in the lessons and reduce their creativity.

Questioning is the most common strategy that teachers use for involving students in the learning process (Glenn, 2001; Amos, 2002). Indeed, Amos (2002) reports that up to one-fifth of what a teacher says in a classroom is likely to be in the form of questions. If teachers ask open-ended questions, they allow students to think freely and flexibly, to express their own ideas and thoughts without thinking that they have to give one 'right' answer. This brings successful discussions in lessons that stimulate students to participate. Amos (2002) supports the use of open-ended questions, arguing that closed and subject-oriented questions that rely on linear processes and logical reasoning discourage students from thinking differently from the teacher and may deter students from answering the questions asked. In addition to the nature of the questions asked, the process of asking questions is also important for students' learning and development. Providing sufficient 'wait time', about 3-5 seconds, after asking a question for students not only increases student participation but also provides them with opportunity to think critically and create more ideas and responses (Trowbridge et al., 2000; Amos, 2002).

Role-playing can also be a useful teaching and learning activity to encourage students to participate more in the lessons and facilitate their understanding. However, researchers report that role-playing in science lessons is underrated and underused, often because of misconceptions about what role-play is and how it can be put to use in science education (McSharry&Jones, 2000). Role-playing supports the reconstruction of the pupil's knowledge. Role-playing activities, rarely used in science classrooms, play a significant role in helping students to learn complex topics. McSharry and Jones (2000) point out that the theory behind the use of role-play in science teaching and learning supports 'active', 'experiential' or 'student-centred' learning. Therefore, students are encouraged to be physically and intellectually involved in their lessons to allow them to both express themselves in a scientific context and develop an understanding of difficult concepts. Furthermore, McSharry and Jones (2000) argue that merely explaining to students about their environment may not be the best method for helping them to gain an understanding of why it is there or how the processes at work in the environment have formed it. However, role-plays, such as those describing predator–prey relationships or antibody–antigen interactions, can give students a chance to experience these events in a physical way, which may be more appropriate to their personal learning style. As a result, students can understand abstract and difficult topics that are not always visible phenomena. Indeed, Cimer(2007) point out that role-playing may be useful in secondary science classes as a way of introducing and familiarising students with difficult, abstract or complex concepts in biology and the physical sciences.

Finally, Role-playing enhances learning in several important ways. Students practice public speaking in a more relaxed format than that of a formal classroom presentation. In addition, role-playing gives students an opportunity to respond to unanticipated questions or situations. Effective scenarios require students to integrate learning from various courses as well as from their work experiences. The discussions can demonstrate that there are various solutions to a particular problem. Role-playing classes employ active learning and should engage all of the students in each session. When the instructor also takes on a role, students can become the “experts” (Schumann, 2002).

In short, student participation is necessary for their learning. Active participation can increase students’ learning, understanding and motivation to learn. With the use of TLMs, Teachers should make sure that students are mentally active in the lessons and create opportunities for them to participate in the lessons.

2.3 Teaching and Learning Materials and their Effective Use

Teaching and learning materials (TLMs) are aids used by the teacher to teach effectively and for learners to learn effectively. Both teaching and learning materials can be big or small. The teaching and learning materials can be bought or made easily by both the teacher and learner. In the traditional classroom teaching there is hardly any scope for the children to interact with the teacher, teaching–learning materials and the teaching-learning environment. So teaching becomes very monotonous and students have to mostly rely on rote learning. Most often classroom teaching is dominated by the Lecture Method of teaching. Except some essential aids like chalk, duster, blackboard, TLMs are hardly used in the classroom. When used it may not be context-specific. Designing, providing for, and enabling appropriate teaching-learning systems could realise the identified goals. Learning has shifted from Response Strengthening to Knowledge Acquisition to Construction of Knowledge. In this context, the duty of the teacher is to provide appropriate environment where the student will construct his/her knowledge by interacting with his/her physical and social environment.

The term TLM is used often and usually refers to some very specific, sophisticated equipment. There is a tendency to believe that it is quite important that a teacher uses TLM in the classroom. If it is not so, it may be understood that one is not using a child-centered and interactive pedagogy. So ultimately, what happens is that every lesson ends up being a demonstration even though that approach might not be appropriate for that particular lesson.

Teaching Learning Materials to the teachers and the learners aim to provide the necessary skills and knowledge along with the inculcation of proper interests and attitudes among them for the effective utilization of the audio-visual aid materials and equipment in the process of teaching and learning (Shri, 2013).

When we say teachers should use TLM, it is understood by default that it should also be prepared by teachers. This may not be the right thing to state or understand though most teachers prepare and use their own TLMs. This was based on the belief that since the teacher is an authority on the topic, he/she can prepare the best TLM if it is not available. Not all TLMs are prepared by the teacher. Teacher only prepares TLMs which are not available in the school and the school cannot afford to buy. If the teacher makes use of some appropriate aid material, he can make things more clear and meaningful to his students regarding any subject. In teaching and learning the sensory impressions play the key role and that is why senses are usually termed as the gateway of knowledge. The use of TLMs in the process of education provide valuable opportunities to the learners to make use of their five sense organs i.e., eye, ear, nose, tongue and skin for gaining valuable knowledge and information.

So, getting back to the effectiveness of TLMs that involves students in lessons through learner-centred approach, TLMs make students have experience, understand lessons and share their knowledge. There are many aspects to TLM. TLMs are not just to be used for demonstration in the classroom and are not to be created and used by the teacher only. According to Deepak (2013; p.3), unless TLM is "By the learners, for the learners and of the learners" it does become just a decorative piece, nothing more. Until teachers involve the learners in the process of making the TLM, that sense of ownership of the process and that level of understanding will not develop. If a facilitator is creative and has a certain level of understanding, he/she may suggest to the students to use the things available from their surroundings. There is no need to rush to the store to buy material.

TLMs help in removing the boredom and monotony of the classroom by adding variety to the classroom activities. They also prove a very good attention in catching device. The students take interest in using materials in learning, listening and watching the things and events told that shows through these aids and in this way a suitable learning environment involving the interest and attention of the students can be properly created through the use of TLMs.

According to Shri (2013), TLMs in Science prove effective reinforcing agent by increasing the probability of the reoccurrence of the responses associated with learners. The experiences are so much connected and associated with the relevant used TLMs that the learner gets sufficient reinforcement for keeping these experiences remembered for a long time. Moreover the TLMs like materials for practical/experiment, teaching machines, computer assisted instructions etc, are known for their role in providing adequate well controlled reinforcement to the learner in his attempt of self learning or instruction. These varying strategies are seen to help improve students' performances in physics.

2.4Instructional techniques in science classroom

The amount of learning that takes place in a student greatly depends on whether the instructional technique(s) is/are compatible with the students' learning styles or not. Studies indicate that if the learner's learning style is compatible with teacher's teaching style, he/she is likely to understand concept easily and retain information longer, apply it more effectively and have a more positive attitude towards the subject than anyone who experience learning disparity. This implies that, a teacher can inculcate in student positive attitude towards science subject, minimize their disruptive behaviour in class as well as their low achievement by adopting teaching pedagogies that match students' learning styles. A teacher must reorganize in diversity in learning styles among students in a class and therefore adopt strategies that are effective and suited to them (Erinosho, 2008). Erinosho (2008) pointed out that, a good teacher is expected to apply a range of active learning approaches that incorporate problem-solving, reading, discussion, experiment, group work and other broad based strategies that can accommodate the differences and similarities in learning styles. Erinosho (2008) again, is of the view that a single lesson may be taught using a combination of techniques, which will engage students' practical work (kinesthetic cue), demonstration (visual cue), hands-on or group work (kinesthetic and active cue), discussion and questioning (verbal, aural, active cue) and drilling exercises (sequential cue).

Three teaching styles are identified by Woods (1995) as discipline-centred, teacher-centred and student-centred. Discipline-centred style focuses more on the subject matter than on what the teacher does. The aim is to teach content as prescribed in the syllabus or textbook regardless of whether it meets the needs of students or not. In teacher-centred style, the teacher is the focus, acting as the authoritative expert, the main source of knowledge, and the focal point of all activity (Erinosho, 2008). In such teaching environment, the students are passive learners and they merely regurgitate content (Erinosho, 2008). The two most common teacher-centred approaches of teaching are lectures and demonstrations. Lecture method is a traditional technique of teaching. It adopts discipline and teacher-centred style (Erinosho, 2002).

Much research evidence suggest that lecture teaching contributes minimally to conceptual understanding in school science and also shot-changes the sensing, visual, active, inductive, and sequential learners (Erinosho, 2008). However, it is useful for introducing a lesson or summarizing the main points in a lesson or providing factual knowledge to students as a group. Demonstration method on the other hand, could be the teacher showing students a procedure or the students showing a procedure to one another. Though classified as teacher-centred, it could be made an active learning procedure if, in providing vicarious experiences, the students are also engaged through questioning or doing a part of the procedure (Erinosho, 2008). Erinosho added that there are many reasons a teacher might want to adopt demonstration techniques, such as when materials are not available to students or because of safety or when the concept might appear difficult for students or if the teacher wants to save time. Using a demonstration requires planning, such as concept or procedure to illustrate, prior knowledge that students need before demonstration, materials that will be combined, the steps or procedure to be carried out ahead of time, questions to be used in directing students' thought processes and stretching exercises to be used to extend students' understanding of the concept (Erinosho, 2008).

Class activities, instructional content, and teaching method are selected to facilitate active learning, encourage independent thoughts and critical thinking, stimulate interest and promote positive attitude towards science (Erinosho, 2008).

Student-centered style allows for a dynamic classroom environment, and is most effective for teaching the "process than product". It focuses on students' cognitive abilities and their interests. The teacher focuses on how to make the students responsible for their own learning by making them take an active role in the learning process, making them to conduct their own investigation, develop their ideas and share the ideas with others through discussion or collaborative work. There is range of teaching techniques for creating a student-centred and active classroom atmosphere (Erinosho, 2008) such as questioning, case study, discussion, simulation, concept mapping, collaborative learning, co-operative learning, and inquiry method.

Studies however indicate that, student-centred style which indicates all opportunity for hands-on activities such as practical work and inquiry method is most effective for teaching science. Inquiry is defined as "the diverse ways in which students study natural world and propose explanations based on the evidence derived from their work (National Research Council (NRC) 1989, cited in Erinosho, 2008), it involves getting students to carry out investigation of natural phenomena through which meaningful problems are answered and new knowledge obtained (Erinosho, 2008). Inquiry-base teaching approach provide useful platform for engaging students in practical, hands-on science investigation that can bring them in interaction with the environment. It may be in a structured form of guide inquiry or unguided or open inquiry. In the guided inquiry approach a teacher generates a problem and gives the step-by-step instruction which involve observations, hypothesis, experimentation, communication findings, measuring, recording, etc. Studies have shown that the inquiry process is a three phase learning cycle which includes exploration, concept introduction and development and application and generalization. In unguided inquiry, the teacher only provides few instructions on the problem and materials, leaving the students to work out the procedure for the design and investigation base upon the cues that are provided in the problem to be solved (Erinosho, 2008).

Open inquiry on the other hand, is similar to guided inquiry. This is because students design the investigation, with the addition that they are free to formulate their own problem. This can be used after the students have gained sufficient experience in observation and exploration as well as understanding of the content in order to be able to formulate problem and design investigation (Erinosho, 2008). Practical work in science like inquiry gives students the opportunity to directly use materials, manipulate object or physical materials, observe or explore characteristics of object and materials, engage in investigations and draw meaningful conclusions.

Research findings indicate that inquiry-oriented instructions are effective to student performance (Anderson & Helms, 2001), promote scientific literacy and understanding of scientific processes, develop critical thinking and skills (Erinosho, 2008) and promote positive attitude towards science mostly physics. Also, effective practical work/lesson provides students with different opportunities and experiences.. Notwithstanding the effectiveness of student-centred instructional approach in a science class, no single teaching technique is enough to fulfill all the needs of a student in a class. All styles can stimulate learning if used appropriately, although the student-centred discussion leads to better retention, better problem solving, better application of knowledge, and better motivation for further learning and an effective teacher is therefore able to adopt an eclectic approach to initiate quality science learning (Erinosho, 2008). There is also the need for the physics teacher to be abreast with how TLMs can effectively be used to enhance the teaching and learning of physics.

2.4.1 Utilization of TLMs in the Teaching of Physics

In order for students to comprehend new ideas or concepts and construct their own knowledge, they need to see clear examples of what the new ideas or skills represent (Trowbridge et al., 2000). Furthermore, in learning new materials or skills, students should be given extensive opportunity to manipulate the environment (Joyce et al., 2000a). Students' cognitive structures will grow only when they initiate their own learning experiences, and students have experience through handling and manipulating with teaching learning materials in performing activities or experimenting (practical's). Teachers should involve students in different tasks where students can engage in cognitive processing activities of organising, reviewing, rehearsing, summarising, comparing, and contrasting with other students, or with the teacher or working alone.

Uses of TLMs therefore provide appropriate introduction and learning of new and complex concepts. They also help in motivating the students to learning thus increasing their participation and concentration. The use of instructional sources would make discovered facts glued firmly to the memory of students.Konyango (2011) also added that a well-planned and imaginative use of visual aids in lessons should supplement inadequacy of books as well as students interest by giving them something practical to see and do, and at the same time helping to train them to think things out themselves.

Teachers use the skills and work on a problem using TLMs whilst discussing the problem. This activity or modeling skills is necessary because when an idea or skill is modeled for students in different ways, they understand the concept better and become meaningful to them, as such devices help students to integrate new information into their existing knowledge structures. As a result, such organization can facilitate retrieval, help students see the relationships among ideas and how they are connected, speed up comprehension, and improve note-taking (Cimer, 2007).

The TLMs to be used by teachers and students should follow the laid down procedure since the TLMs are to be utilized for their benefit. There should be regular stock taking and updating of the inventory on some of them provided by the school. Available TLMs should be known and conditions under which they can be utilized should also be spelt out to avoid unnecessary damages and cause accident.

Physics is an experimental subject and the teaching and learning of it needs a lot of teaching learning materials (TLMs) like bar magnet, spring balance, ammeter, voltmeter, thermometer, resistor, galvanometer, rheostat, measuring cylinder, stop watch, pendulum bob, etc, to involve students in practical/experiments for them to understand simple concepts.

Practical work can provide a good opportunity for students to apply their newly acquired knowledge or skills and gain first-hand experience of phenomena talked about in theory (Amos &Boohan, 2002). When students engage in practical work, they can test, rethink and reconstruct their ideas and thoughts. For these reasons, many studies reported that practical work improved students' learning and understanding (Dawe, 2003). Dawe (2003) argues that such positive outcomes may be as a result of students' gaining ownership over the concepts they learn as they 'discover' the knowledge themselves during practical work. In relation to practical work, simulations can be used to replace laboratory work when laboratory work cannot be done in schools (Peat & Fernandez, 2000). So, they can help students understand invisible conceptual worlds of science through animation, which can lead to more abstract understanding of scientific concepts (Joyce et al., 2000b; Hwang &Esquembre, 2003). Students can understand not only just what happens, but also how and why. Using simulations in teaching science lessons improves students' higher order skills like application and analysis, and thus, helps them to understand the concept of the topic better.

Poor achievement of student may not be separated from unavailability and inadequate use of TLMs for teaching, as well as instructional materials as observed by Oladejo, Olosunde, Ojebisi and Isola (2011). Laboratory apparatus and equipment (example, bar magnet, spring balance, ammeter, voltmeter etc) found in physics laboratory which are used for practical work is the 'heart' of science learning and where not found or insufficient, students' academic achievement will be very low or poor. According to Akanbi (2003) that inadequate laboratory equipment and facilities lead to students' poor performance in physics. Community resources is also very important to the teaching and learning of science; the result of this study indicating students not going to excursion is not good for effective learning of physics. Besty (2012)affirmed that community service was beneficial to students' learning because of its connection to their prior science.Bestyfurther averred that what student learnt in classroom in theory becomes meaningful to students when they experience this in the community through excursion to see real things. Poor achievement of students in physics could be linked to the way students learn some concepts; many of these concepts look abstract since they have not seen or come across such concepts in action before.

The utmost significance in studying how best education TLMs can be utilized is in the endeavour not only for schools to be efficient but also in the process allow for higher enrolment of students and provide greater opportunities for all. According to Olel (2000) studies show that the three main challenges of educational development are improving access to learning, improving effectiveness of education and training systems and mobilizing the TLMs for both.

2.4.2 Demands' on teacher's pedagogical skills.

Teacher's pedagogical skills are crucial in learner-centred instructions which are designed to engage students in the process of formulating prediction, organizing, sharing ideas, asking questions and interpreting data, and communicating results using science technology. This is even more crucial if the teacher lacks sufficient classroom equipment and materials (TLMs). This approach has great potential to excite and motivate but requires preparation and forethought to implement successfully (National Science Teachers Association (NSTA), 2009). For students to be actively involved there is a need for adequate equipment or TLMs and text books. However, most schools in West Africa mostly in Ghana have inadequate or no equipment at all due to government low funding of education sectors. Environment like these can make it difficult for teachers to implement constructivist practices. The above scenario suggest that, without teachers skills including teachers content knowledge and pedagogical roles such as facilitative teaching, helping students to develop element of curiosity and creativity in asking questions, designing experiments, analysing and interpreting data, and drawing conclusion, could wreak havoc in science classrooms (Jeanpierre, Oberhauser&Freeman, 2005). Therefore based on the evidence this study aimed at the effects of learner-centred approach and TLMs on students' performance in physics in colleges of education in Ghana. This was thought to be favourable to support physics teachers' improvement of classroom instructional approaches, which in turn could improve student learning outcomes.

2.5 Theoretical framework

The theoretical framework on which this study is based on is the constructivist theory of learner-centred learning proposed by Anderson (2008). According to Anderson (2008), Constructivist theorist claim that learners interpret the information and the world according to their personal reality, that they learn by observation, processing, and interpretation, and then personalise the information into personal knowledge. Learners learn best when they can contextualize what they learn for immediate application and personal meaning. They do these through the sharing of ideas by learning together and the teacher being the facilitator.

Constructivists believe that learners construct their own reality or at least interpret it, based upon their perceptions of experiences, and so an individual's knowledge is as a result of one's prior experience, mental structures, and beliefs that are used to read between the lines of objects and events. What someone knows is grounded in perception of the physical and social experience which is comprehended by the mind. Constructivists contest for understanding how learners construct knowledge, the environment that supports the learners, the social nature of learning, and the role of the teacher in the learning process.

Learner-centred teaching is based on constructivist teaching methods where the student has an active role and isat thecentre of the learning process (Elen, Clarebout, Leonard &Lowyck, 2007). Constructivism emerged from an irrevocable break with Western intellectual thought: it was the idea that knowledge does not and cannot have the purpose of producing representations of an independent reality as advocated by behaviorists'. Constructivists argue that there are multiple realities constructed by individuals.

There are several types of constructivism, among which are the cognitive, critical, radical, and social constructivism. However they have a common idea that learners actively construct their own knowledge in learning process where they try to find meaning in their experiences. Constructivist theorists argue that knowledge cannot be imposed from others; it has to be formed inside learners. This is because individuals construct knowledge based on their beliefs, their experiences and according to situations in which they find themselves. Thus the thinking subject has no choice but to construct what he or she knows on the basis of his or her own experience (Von Glasersfeld, 2005). What an individual constructs as knowledge is true to that individual only and not necessarily to someone else. All knowledge is subjective and personal.

Constructivist teaching and learning has heavily influenced learner-centred practices (Schweisfurth, 2011). Constructivism views learning as "an interpretive, recursive, nonlinear building process by active learners interacting with their surroundings, the physical and social world" (Fosnot, 2005, p. 34). According to this definition, learning is interpreted by the learner's senses; it is moulded by how the learners shed old beliefs and adopts new ones, by how learners construct their own understanding of the world by reflecting on their experiences. Learning is built by prior knowledge and there is ownership of learning when learners act on the information received (Von Glasersfeld, 2005). This means that the teacher needs to help learners construct their own meaning rather than look for the "right" answer as is practiced in traditional classrooms.

Constructivist teaching and learning differ from traditional ones in the way they ascribe construction of knowledge to social interactions with teachers and peers. For the constructivist teacher learning does not occur in a vacuum but within a social context. Sociocultural constructivist perspectives in education have been largely inspired by the work of Vygotsky (1978) who emphasised the importance of the social as instrumental in the construction and appropriation of knowledge. Vygotsky thought that social environment was critical for learning and that social interaction transformed learning experiences. In practice the tutor and the learner create understanding and meaning together. This concept is possibly the most important for tutors taking a learning-centred approach in that it shares the responsibility of creating and delivering learning. With this theoretical framework, the researcher has focus on the use of TLMs, which when in used with the learner-centred approach/method, will interest students to be active and participate well in lessons, conceptualise and comprehend abstruct and difficult ideas, thought, and data better in their minds, store and remember the concept more efficiently.

CHAPTER THREE

METHODOLOGY

3.0 Introduction

This chapter deals with the research methodology that was employed in this study. It covers the research environment, the research design, research population, sample and sampling techniques, instrument for data collection, classroom observation, interview, questionnaire, validity of instrument, reliability of the instrument,data collection procedure, data collection and data analysis procedure.

3.1 Research Environment

The study was conducted in three colleges of education namely; Fosu College of Education, Komenda College of Education and SefwiWiawso College of Education.

Foso College of Education is located on a low land and of about one kilometer square. It is situated between the cities of Cape Coast and Kumasi on the Cape Coast Kumasi Highway at the southern outskirt of a town called AssinFoso in the Central Region of Ghana. This part of the region where the college is located is Assin North Municipal which is dominated by forest vegetation. Majority of the people in this town are traders and the remaining others are farmers.

Komenda College of Education is also located in the Central Region of Ghana. It is however, located about twenty five (25) kilometres away from Cape Coast in the Southern part of the city. It is located on a hill a few meters away from sea the shore in the Coastal town called Komenda. The pre-dominant occupation of the people in this community is fishing.

SefwiWiawso College of Education is located in Wiawso in the SefwiWiawso Municipality in the Western Region of Ghana. The school is found in the serene environment of a high hill in the suburb of the town called Kesekrom. The school has a land size of 3 kilometers dominated by forest vegetation. The pre-dominant occupations of the people in the community are trading and farming.

3.2 Research Design

This research was designed to verify the effects of the use of TLMs and learner-centred approach on student's performance in the learning of physics in the colleges of education in Ghana. The researcher therefore used both quantitative and qualitative survey (mixed method) design for this study.

Creswell and Clark (2006) provided the definition of mixed methods which served as a guide for this study. A mixed method is a research design with philosophical assumptions as well as methods of inquiry. As a methodology, it involves philosophical assumptions that guide the direction of the collection and analysis of data and the mixture of qualitative and quantitative approaches in many phases in the research process. As a method, it focuses on collecting, analyzing, and mixing both quantitative and qualitative data in a single study or series of studies. Its central premise is that the uses of quantitative and qualitative design in combination provide a better understanding of research problems than either approach alone(Creswell and Clark, 2006). This mainly involves the use of observation, interview (qualitative) and questionnaire (quantitative) to collect data. Upon the strategies used in mixed method, the researcher chose the Sequential procedures, in which the researcher seeks to elaborate on or expand the findings of one method with another method. This may involve beginning with a qualitative method for exploratory purposes and following up with a quantitative method with a large sample so that the researcher can generalize results to a population. Alternatively, the study may begin with a quantitative method in which theories or concepts are tested, to be followed by a qualitative method involving detailed exploration with a few cases or individuals. This mixed method design was adopted to enable the researcher to sample the views of a wide variety of research subjects on the problem investigated.

3.3 Population for the Study

There are thirty eight (38) colleges of education in Ghana. Fifteen (15) of them are classified as Science and Mathematics Colleges of Education. At least one (1) of such colleges is established in each of the ten (10) regions of Ghana. The target population for the study therefore consisted of all science students in the three Colleges of Education in Ghana, namely Komenda College, Foso College and SefwiWiawso College including physics tutors in these colleges were also part of the population.

3.4 Sampled and Sampling Techniques

The respondents comprised all second year science students studying physics and one of the tutors teaching physics in the three selected science colleges of education. The researcher chose the second year students because they had treated almost all major topics in physics. Table: 1 shows the number of second year science students and a physics tutor selected per college for the study.

Table 1: Number of science students and tutors selected per college

College	No of science students	No of tutors
Foso College of education	30	1
Komenda College of education	30	1
SefwiWiawso College of Education	30	1
Total	**90**	**3**

The selected sampled were observed, interviewed and responded to questionnaires. The purposive sampling technique was employed by the researcher because the researcher's place of work and home are both close to the selected regions. The researcher purposively selected the subjects to include only second year science students because they offer physics as one of their major courses, which was the focus of the research. According to Cohen, Manion and Morrison (2007), in the purposive sampling technique, the sample is chosen for a specific reason. Purposive sampling represents a group of different non-probability sampling techniques. Also known as judgmental**,** selective or subjective sampling, purposive sampling relies on the judgment of the researcher when it comes to selecting the units that are to be studied (Cohen et al, 2007).

Students and tutors were purposively selected using the homogeneous purposive sampling for the research. Homogeneous sampling is a purposive sampling technique that aims to achieve a homogeneous sample; that is, a sample whose units share the same (or very similar) characteristics or traits(Cohen et al, 2007). Purposive homogeneous sampling was used to select students from each of the colleges because the students were science students studying physics as one of their major courses in science with the same course outline. These colleges are close to the researcher.

3.5 Instrument for Data Collection

The instruments for this study werequestionnaires on five point Likert type scale, interview and observational checklist. The questionnaire was used because the respondents were at a wide coverage area. According to Center for Continuing Education (CCE) (2005) of University of Cape Coast, the merits of using questionnaire include reach ability where many respondents can be reached more easily. Again, the results of the questionnaires can usually be quickly and easily quantified by either a researcher or through the use of software package. Two different questionnaires were designed for both science students and physics tutors in the colleges of education. The researcher developed the questionnaires (Appendix A and B) which were set from the four research questions of this study. Questionnaires which were developed base on each research question were to be responded by both science students and physics tutors in this study. The questionnaires for both students and tutors had two parts. Section 'A' was meant to collect information on the respondents' biography, and section 'B' was about statements to be responded on a five point Likert type scale.

Questionnaire for research question one (1) for the students contained nineteen (19) items that solicited information from the students regarding on how co-operative learning and enquiry encourage students learning performance in science. Students were expected to respond by ticking the level of agreement with a statement. The questionnaire contained five point Likert type scale reading SD (Strongly Disagree); D (Disagree); N (Neutral); A (Agree); and SA (Strongly Agree).

The questionnaire items to answer Research question two (2) of students contained ten (10) items. These items solicited information from the students on how learner-centred instructional strategy will be effective in encouraging participation of students in physics lessons. This had five point Likert type scale with the rating of SD (Strongly Disagree); D (Disagree); N (Neutral); A (Agree); and SA (Strongly Agree). Students were expected to tick the agreement level with a statement.

Research question three (3) contained twelve (12) items which sought to collect information from the science students on how effective physics tutors use TLMs in teaching them physics. This part had five point Likert-scale, SD (Strongly Disagree); D (Disagree); N (Neutral); A (Agree); and SA (Strongly Agree) from the students' agreement levels.

Research question four (4) also had twelve (12) selected items for the science students which were developed to collect information from them on the use of learner-centred instructional approach and the help of TLMs in the improvement of performance in physics. Here, participants reported on their perceived improvement on their performance in physics when their tutors used learner-cented approach and TLMs to teach them. This part also had a five Likert-scale: SD (Strongly Disagree); D (Disagree); N (Neutral); A (Agree); and SA (Strongly Agree) seeking from the students their agreement levels on each statement.

Appendix B contained questionnaires set to answer each of the four research questions meant for physics tutors. Questionnaire set for physics tutors for research question one (1) was to seek information on how co-operative learning and enquiry encourage students learning performance in science. This questionnaire contained ten (10) items.

Questionnaire set to answer research question two (2) had ten (10) items set for physics tutors to gather information from them on how learner-centred instructional strategy will be effective in encouraging students' participation in physics lessons.

Questionnaire set to answer research question three (3) had eleven (11) items that sought information from the physics tutors on effective use TLMs in teaching physics lessons.

Questionnaire set to answer research question four (4) also contained ten (10) items. All these items had five point Likert-scale reading SD (Strongly Disagree); D (Disagree); N (Neutral); A (Agree); and SA (Strongly Agree) which sought to collect information from physics tutors by measuring their level of agreement with each statements regarding the use of learner-centred instructional approach and TLMs as a way of helping in the improvement of students' performance in physics lessons. Tutors were to tick the scale they agreed with in the items.

Items set for Interview were used to determine if there will be any inconsistency in the responses giving and the observations made. In particular, a semi-structured interview was employed. The interview was used in order to obtain additional information that could not be obtained only from observation and responses to the questionnaire. Creswell (2002) stated that although semi-structured interview have structured questions, the order can be modified based upon the interviewers perception of what seems most appropriate, thereby allowing for the omission of inappropriate questions. Thus, semi-structured interviews have the advantage of supplying large volumes of in-depth information based on the respondents' opnions, believes and feelings about the situations in their own words (Ary, Jacobs &Razavieh, 2002).

In semi-structured interviews, the pre-determined questions can be modified in order to remain as open and adaptable as possible to the interviewee's nature and priorities. Consequently, semi-structured interviews should be tightly focused to elicit the kind of information the researcher wants to get. These interviews allowed the researcher to further probe into students and tutors to seek information on the use of learner-centred approach and TLMs during physics lessons. Participants were verbally assured by the researcher that there would be confidentiality in the handling of any data or information obtained from them.

The researcher formulated an interview questions for physics tutors and science students from the items contained in the observational checklist which contained twenty (20) items. These questions were seeking information about how physics tutors used TLMs and learner-centred approach to teach physics and how learners used it to improve their learning in the lesson during the study. The researcher developed an interview (Appendix C) that guided the class interview process.

Lastly, an observational checklist was employed for both physics tutors and science students by the researcher as a means of confirming the data gathered from the questionnaire and interview. The same checklist was used for both tutors and the students. An observation checklist is a list of questions that an observer will be looking to answer when they are doing a specific observation of a classroom. The checklist helps the researcher to record information without the need to write narrative description of observation. This checklist is often given to the researcher/observer to ensure that there is clear communication between the teacher, the students and the observer in the classroom.

The structured observation technique was used. The researcher developed an observational checklist (Appendix D) that guided the class observation process. For this non-participatory observation, the researcher did not participate but remained an outside observer in the lessons that were delivered.

3.6 Classroom observation

Observation in the research context involves the systematic viewing of people's actions and the recording analysis and the interpretation of their behaviour (Saunders, Lewis &Thornhill, 2000). The distinctive feature of observation as a research process is that, it offers an investigator the opportunity to gather "live" data from natural occurring social situations (Cohen et al, 2007). This study employed only the structured observation with the assistance of a curriculum profile classroom observation checklist during the field implementation stages of curriculum materials (TLMs) and the learner-centred approach in teaching physics, it effects on students performance. A curriculum profile is a set of statement about the teachers' roles and students' classroom activities during lesson observations.

The main advantage of observational checklist is its directness; it enables researchers to study behaviour in real time as it occurs. The researcher does not have to ask people about their own behaviour and the actions of others; he or she can simply watch them act and speak. This enables the researcher to collect data firsthand, thereby preventing any contamination or distortion of the data by factors or event standing between him or her and the object of research. Both tutors and students were observed during the teaching/lesson, where students were actively involved in the lesson (learner-centred) using Teaching Learning Materials (TLMs) and the researcher ticking the appropriate items on the checklist.

In all, three physics lessons were observed during the study period, one lesson from each college. The observation identified teaching method and students' participation in the lesson, tutors attitude and their competence levels in the use of TLMs. The observation enabled the researcher to observe the impact of the use TLMs and learner-centred approach had on students' learning and how they responded to the lesson.

3.6.1 Interview

Interviews can be used to gather in-depth information about a person's knowledge, values, preferences and attitudes, and can be used in conjunction with other research techniques, such as surveys, to follow-up issues (Gray, 2009). The common type of interview discussed in the literature is the semi-structured interview. In qualitative research, open-ended questions are asked so that participants can voice out their experiences without any constraints placed on them by the researcher (Creswell, 2002). These types of questions represent the most frequently used form of interviewing in qualitative studies, which allow the participant to create response possibilities.

Conducting interviews in order to collect information has both advantages and disadvantages. They provide useful information that cannot be obtained from observations, and allow participants to describe detailed personal information and experiences. One disadvantage is that they may be "filtered" (Cresw`ell, 2002, p.205) through the perspective the participants wants the researcher to hear.

During the study period, the researcher interviewed some students and their physics tutor from each of the three selected colleges. The physics tutors were selected and interviewed because they teach these students and know the situations/conditions involved with the use of their physics laboratory for practical activities. The interviews were set from the items in the observational checklist which are crucial to the study because it provided useful information that could not be obtained from the responses of the questionnaire. The semi-structured discussion format was used to enable the participants engage in conversation and freely express themselves in a relaxed manner and this may be more suitable for obtaining in-depth information. The questions were focused on the use of TLMs and learner-centred approach in teaching physics in improving the performance of students, purposely in colleges of education. The interview lasted for ten (10) minutes for each interview session.

3.6.2 Questionnaires

Questionnaires are research tools through which people are asked to respond to the same set of questions in a predetermined order (Gray, 2009). The questionnaire is widely used and useful instrument for collecting survey information, providing structured, often numerical data, which can be administered without the presence of the researcher and often being comparatively straightforward to analyse (Cohen et al, 2007).

This study used a structured questionnaire with closed-ended questions in order to obtain tutors and students' opinions with numerical component for easy analysis quantitatively on the various parts of the response. The questionnaire is constructed for both tutors and students to answer. These questionnaires/items were constructed in line with the students' attitudes/behaviours towards the use of TLMs and learner-centred approach to learn physics, to verify the effects on students' performance. The dimension scale: students' interest/enjoyment in physics, theirmotivation/encouragement to learn physics with the use of TLMs, their involvement in physics lessons through the use of TLMs in practical's/activities which they are much involved in to share ideas to bring solutions and findings (learner-centred). Physics tutors were also given questionnaires to answer in finding out how effective they use TLMs and learner-centred approach to teach physics lessons. The questionnaires/items were based on the research questions with the use of TLMs and learner-centred approach for teaching and learning physics.

Each of the items in the questionnaire for both tutors and students were scored on a five point likert type scale with every item scored one (1) for "Strongly Disagree", and five (5) for "strongly agree" There are also intermediate scores of 2 which represents "Disagree" 3 which means "Not Certain" and 4 meaning "Agree". Respondents were to select from these intermediate score depending upon one's disagree of agreement with a particularly question item or statement.

3.7 Validity of Instrument

In this study the researcher has taken a particular care to present the design and effects as narratives that describe the practices of participants, and the context within which these effects are located. This study has involved a number of participants and care was taken to document the practice in an on-going manner for example interactive activities during the study, i.e learners interacting with the TLMs to make inquiry, sharing ideas together and coming out with solutions. Similarly, students and tutors feedback, review and researcher's observation helped to document the practice in detail and at the same time the researcher was able to clarify the personal perspective and the possible effects it could have on outcomes in a reflexive way. This study employed triangulation design in order to corroborate findings from qualitative and quantitative methods employed in the answering of the research questions. The study adopted the convergence model of triangulation (Creswell &Planoclark, 2007), whereby the researcher collected and analysed qualitative and quantitative data from different sources separately for each research question. Thereafter, the two datasets were merged or converged (by comparing and contrasting the different results) during the interpretation of the findings so that a complete analysis could be developed from both datasets.

The questionnaire, interview and observational checklist were first vetted by the researcher, colleague tutors and later the researcher's supervisors who read through and critiqued the items. Based on their recommendations, some items were modified while others which were found to be unsuitable were discarded. This was done to improve the validity of the instruments. To ensure content validity of the instruments, the content of the questionnaire items addressed the research questions specifically. In summary, they all agreed that the instrument was appropriate for the intended purpose.

3.7.1 Reliability of the instrument

Reliability points to the "degree to which measurement can be replicated" (Hoadley, 2004: 204). Reliability implies that repeated measurements of the same phenomenon are able to produce consistent results. Joppe (2000: p.1) defines reliability as "the extent to which results are consistent over time and an accurate representation of the total population under study is referred to as reliability and if the results of a study can be reproduced under a similar methodology, then the research instrument is considered to be reliable".

A high degree of stability indicates a high degree of reliability, which means the results are repeatable. We cannot be sure that there was no change in extraneous influences such as an attitude change that has occurred. This could lead to a difference in the responses provided. Scores may change due to some characteristic of the respondent, which may lead to errors of measurement. These kinds of errors will reduce the accuracy and consistency of the instrument. Hence, it is the researchers' responsibility to assure high consistency and accuracy of the respondents. Although the researcher may be able to prove the research instrument repeatability and internal consistency, and therefore reliability, the instrument itself may not be valid.

In determining the quality or consistency of the instrument for this study, the questionnaire was pilot tested with ten (10) students and two physics tutors at OLA College of Education. This college was not part of the selected colleges for the research. Four days later, the questionnaire was again given to the same students and tutors to answer in order to check for the stability of the questionnaire items. Their responses were analysed using Pearson's Product Moment Correlation Formula (See Appendix A and B) and this yielded a correlation coefficient of 0.88. A correlation above 0.75 is considered to be relatively strong; correlations between 0.45 and 0.75 are moderate, and those below 0.45 are considered weak. The result which yielded 0.88 proves the reliability of the questionnaire.

3.8 Data collection

This study used mixed methods as a procedure for data collection and analysis (Creswell 2007; Tashakkori&Teddlie, 2003a). The major purpose of mixing qualitative and quantitative approaches and methods of data collection for this study was to seek confirmation of the research findings in order to increase their validity and credibility (Greene, 2007; Bryman, 2008). The study adopted triangulation in order to seek convergence and corroboration of findings from different sources and methods which study the` same phenomenon for the purpose of obtaining complementary data (Creswell, 2007). When results from triangulation provide consistent or convergent information, then the confidence in inquiry inferences increases.

An introductory letter was taken from the Head of Science Education Department, University of Education, Winneba, to the Principals of the various colleges where the research was conducted. When permission was granted by the Principals of the institutions, the Principals from the selected colleges of education were personally contacted. Data concerning the use of learner-centred approach and TLMs for teaching physics were collected through a questionnaire, interview and observations.

3.8.1 Data Collection Procedure

Visits were made to the three selected colleges on different days. Permission was sought from the authorities of the colleges (Principals and Heads of Science Departments) for the researcher to administer the questionnaire. Selected physics tutors were given the appropriate information and instructions on teaching the lesson using the approaches: learner-centred and TLMs to teach the topic 'HEAT ENERGY'.

Questionnaires were given to students to complete independently and collected after the lesson. The items were answered under my personal supervision with the help of some of the science tutors in the departments. Subjects were given enough time to answer the questions according to their levels of agreement or disagreement to each of the items. The use of observational checklist was done by the researcher, both for teacher and students as the lesson was in progress. Some interviews were done for students and physics tutors by the researcher, semi-structured one to get some explanations on some items answered in the questionnaire.

3.8.2 Data analysis procedure

Data concerning the use of learner-centred approach and TLMs to teach physics were collected using questionnaire, interview and observational checklist. The study collected both quantitative and qualitative data to answer the four main research questions. For each question both qualitative and quantitative data were analysed separately and merged during the interpretation of findings in order to gain an in-depth understanding (Creswell &Planoclark, 2007). The questionnaire responses were anlysed using the SPSS. The interviews were analysed using content analysis. The classroom observational checklists were analysed and analyzing classroom behaviour of the students.

3.8.3 Summary of the chapter

This chapter presents the rationale of adopting the use of learner-centred instructional approach and TLMs for teaching physics in colleges of education, its effects on students' performance. The design was based on mixed methods in order to acquire in-depth understanding of findings and their interpretations. This was achieved through convergent triangulation design whereby the researcher collected and analysed qualitative and quantitative data separately for each research question and later merged during the interpretation of findings in order to maximize their validity and credibility.

The chapter also describes the aspects of Research Environment, Research Design, Population for the Study, Sample and Sampling Techniques, Instrument for Data Collection, Classroom Observation, Interview, Questionnaire, Validity of Instrument, and Reliability of the Instrument, Data collection, Data Collection Procedure and Data analysis procedure.

CHAPTER FOUR

FINDINGS AND DISCUSSION

4.0 Introduction

This chapter presents the findings of the study, based on the analysis of data collected for the study. The researcher blended the discussion with the presentation of results.

4.1Characteristics of Respondents

Respondents' demographic characteristics include the second year science students in Colleges of Education and their physics tutors.

4.1.1 College Respondents

Ninety (90) second year science students and three (3) physics tutors were used for the study. Out of this, thirty (30) science students and one (1) physics tutor were selected from each of the three Colleges of Education; namely, Komenda, Fosu and Wiawso College.

4.1.2 Data presentation by Research Questions

Table 2: Encouraging students learning performance in science through co-operative and enquiry learning

No	Statement	SD (%)	D (%)	N (%)	A (%)	SA (%)
1	Learning physics alone in class is difficult for me	0 (0)	0 (0)	0(0)	70(78.8)	20(22.2)
2	Learning physics in groups help me to share ideas with friends.	0 (0)	0(0)	0 (0)	55(61.1)	35(38.9)
3	Physics lessons are understood when tutor uses lecturing method	83(92.2)	7 (7.8)	0 (0)	0 (0)	0 (0)
4	Physics lessons are understood when tutor involves students in activities	0 (0)	0(0)	0 (0)	62(68.9)	28(31.1)
5	Making enquiry in physics lessons encourage students to participate	0 (0)	0 (0)	0 (0)	61(67.8)	29(32.2)
6	Sharing ideas with friends during physics lessons encourage students to participate effectively	0 (0)	0 (0)	0(0)	67(74.4)	23(25.6)
7	Learning in groups in class brings about co-operative learning	0(0)	0 (0)	0(0)	60(66.7)	30(33.3)
8	Discussion as in Co-operative learning helps students to share ideas together.	0 (0)	0 (0)	0 (0)	69(76.7)	21(23.3)
9	Brainstorming as in Co-operative learning helps students to perform better in class.	0 (0)	0 (0)	0(0)	73(81.1)	17(18.9)
10	Making enquiries as in co-operative learning encourages students to find solutions for themselves	0 (0)	0 (0)	0 (0)	55(61.1)	35(38.9)
11	Doing practical work in physics lessons help students to make enquiries	0(0)	0 (0)	0 (0)	52(57.8)	38(42.2)
12	Making enquiries help students to co-operate with each other.	0 (0)	0 (0)	0(0)	47(52.2)	43(47.8)
13	Making enquiry in physics lesson encourages students to participate effectively	0 (0)	0 (0)	0 (0)	59(65.6)	31(34.4)
14	Making enquiry in physics practical work help students to perform better in class	0(0)	0 (0)	0(0)	72(80.0)	18(20.0)
15	Making enquiry during practical work helps students to co-operate well with friends	0 (0)	0 (0)	0 (0)	66(73.3)	24(26.7)

No	Statement	SD (%)	D (%)	N (%)	A (%)	SA (%)
16	Making enquiries in physics practical work help students to understand physics better	0 (0)	0 (0)	0 (0)	68(75.6)	22(24.4)
17	Making enquiries and co-operating with friends makes students active in class.	0 (0)	0 (0)	0 (0)	69(76.7)	21(23.3)
18	I learn to work with students who are different from me.	0 (0)	0 (0)	0(0)	70(77.8)	20(22.2)
19	I enjoy the material more when I work with other students.	0 (0)	0 (0)	0(0)	70(77.8)	20(22.2)

SD – Strongly Disagree; D – Disagree; N – Neutral; A – Agree; SA – Strongly Agree. Figures in bracket are percentages

The data collected were presented based on the questionnaires formulated from the four research questions for the study. Questionnaires containing five pointlikert scales (1= Strongly disagree (SD), 2= Disagree (D), 3= Neutral (N), 4= Agree (A), 5= Strongly agree (SA).

Research question 1 was answered by the respondents using the statements of the questionnaire. Statements were placed in the questionnaire to elicit the second year science students' views on the issue. Data in Table 2 above shows the frequency and percentage responses given from research question 1.

The responses indicate that total percentage (100%) of the students agreed and strongly agreed to the statements set from research question 1, apart from statement 3 which shows that all the students (100%) either strongly disagreed or disagreed with the statement "*Physics lessons are understood when tutor uses lecturing method*". Statements 1, 2, 4 to 19 are highly accepted by the students; they agree and strongly agree to these statements. This shows that when tutors in colleges of education involve their students in co-operative and enquiry learning, it helps and encourages them to learn better. Cimer (2007) holds the view that encouraging students to work or co-operate with each other in constructing their own understanding has been a highly valued principle of effective teaching in science. Joyce, Weil and Calhoun (2000a) therefore believed that co-operative learning can foster the development of deep understanding. From Khan and Iqbal (2011), they believe that inquiry-based science lesson is a student-centered method of teaching which provides students with the opportunity to ask questions and follow instructions to arrive at new knowledge, and provide students in a science class the opportunity to think and reason critically. Cimer (2007) also suggested that teachers should provide 'focus', which means that inquiry is a purposeful activity, a search for particular meaning in some event, object or condition that raises questions in the inquirer's mind. This indicates that there is emergence of co-operative and enquiry learning which makes students active participants in lessons and increases their performance. This implies that physics tutors should be able to engage their students in co-operative and enquiry learning to share ideas and improve their performance.

Research Question 2: How will learner-centred instructional strategy be effective in encouraging student's participation in physics lessons in colleges of education?

Research question 2 was answered by the respondents using the statements of the questionnaire. Statements were placed in the questionnaire to elicit science student(s) views on the issue. Data in Table 3 shows the frequency and percentage responses from research question 2 and outcomes were analysed using percentages.

Table 3: Using learner-centred instructional strategy in encouraging studentsparticipation in physics lessons in colleges of education.

No	Statement	SD (%)	D (%)	N (%)	A (%)	SA (%)
1	Interactive learning encourages students to participate well in physics lessons	0(0)	0 (0)	0(0)	63(70.0)	27(30.0)
2	Learner-centred physics lessons help students to perform better	0(0)	0(0)	0(0)	43(47.8)	47(52.2)
3	Learning physics in groups help students to participate well in class	0 (0)	0(0)	0(0)	47(52.2)	43(47.8)
4	Sharing ideas with colleagues during physics lessons encourage students to be active.	0(0)	0(0)	0(0)	52((57.8)	38(42.2)
5	Participating in physics lessons help students to share ideas and ask questions from colleagues	0(0)	0 (0)	0(0)	69(76.7)	21(23.3)
6	I enjoy physics lessons when the tutor allows us to share ideas about the topic to find solutions for ourselves	0(0)	0(0)	0(0)	59(65.6)	31(34.4)
7	Sharing ideas in class during physics lessons encourage students to perform better	0(0)	0(0)	0(0)	40(44.4)	50(55.6)
8	Physics lessons become interesting when a lesson is centred among students and tutor acts as a facilitator.	0(0)	0(0)	0(0)	42(46.7)	48(53.3)
9	Working in groups encourages learners to share ideas in physics lessons	0(0)	0(0)	0(0)	58(64.4)	32(35.6)
10	Interacting classroom situation helps students to ask questions in physics lessons.	0(0)	0(0)	0(0)	69(76.7)	21(23.3)

SD – Strongly Disagree; D – Disagree; N – Neutral; A – Agree; SA - Strongly Agree. Figures in bracket are percentages.

The responses from the statements from research question 2 indicated that all the students constituting 100% who participated in the study agreed and strongly agreed to statements 1 to 10 in research question 2. This shows that the use of learner-centred approach for teaching physics in colleges of education is more effective in encouraging students' participation in lessons. Anderson, Balsamo, Buche, Carnicke and Chrystal (2006) viewed that "learner-centered" describes a concept and a practice in which students and teachers learn from one another. Taras (2002) suggests that learner-centred learning has, in theory, promoted and brought about greater student participation and involvement. During learner-centred learning, Khan and Iqbal (2011) believe that the teacher then acts as a co-learner or a facilitator showing interest in the students' activity. Learner-centred is also said to make use of the linkage and reconstruction of the new and existing knowledge as expressed by American Association of the Advancement of Science (AAAS) (1990). This implies that when physics tutors use learner-centred approach to teach lessons, it will encourage learners to participate well in lesson, learn from each other and able to make new knowledge. This will increase learner's participation in lessons, making them active and improve their performance.

Research Question 3: How effective do physics tutors use TLMs in teaching physics in the colleges of education?

Research question 3 was answered by the respondents using the statements of the questionnaire. Statements were placed in the questionnaire to elicit the second year science students' views on the issue. Data in Table 4 shows the frequency and percentage responses given from research question 3.

Table 4: Physics tutors using TLMsto teach physics in colleges of education.

No	Statement	SD (%)	D (%)	N (%)	A (%)	SA (%)
1	Physics tutor uses TLMs to teach physics regularly.	30(33.3)	60(66.7)	0(0)	0(0)	0(0)
2	There are no TLMs in the school physics laboratory	0(0)	86(95.6)	0(0)	4(4.4)	0(0)
3	Physics tutor uses demonstration because materials are not available	1(1.1)	81(90.0)	0(0)	8(8.9)	0(0)
4	Tutors do not involve students in activities/practical work	0(0)	1(1.1)	2(2.2)	78(86.8)	6(10.0)
5	Our physics laboratory is well furnished with materials and equipment	1(1.1)	58(64.4)	1(1.1)	30(33.3)	0(0)
6	Tutors allow students to prepare TLMs on their own for physics lessons	0(0)	27(30.0)	5(5.6)	50(55.6)	8(8.9)
7	Physics tutors involve students in practical work using TLMs	1(1.1)	86(95.6)	1(1.1)	2(2.2)	0(0)
8	Using TLMs in physics lesson makes students to have a firsthand experience.	0(0)	0(0)	0(0)	75(83.3)	15(16.7)
9	Physics lessons are better understood when tutor involves students in practical lessons using TLMs	0(0)	0(0)	0(0)	65(72.2)	25(27.8)
10	Physics tutor uses TLMs to teach	6(6.7)	83(92.2)	1(1.1)	0(0)	0(0)
11	The use of TLMs in physics help students to understand lessons taught	0(0)	0(0)	0(0)	73(81.1)	17(18.9)
12	Tutors allow students to use materials for practical lessons	2(2.2)	88(97.8)	0(0)	0(0)	0(0)
13	TLMs are available in physics laboratory for activities/practical	1(1.1)	58(64.4)	2(2.2)	28(31.1)	1(1.1)
14	TLMs in physics class room makes students to see real materials and physics interesting	0(0)	0(0)	0(0)	71(78.9)	19(21.1)

SD – Strongly Disagree; D – Disagree; N – Neutral; A – Agree; SA – Strongly Agree. Figures in bracket are percentages.

Responses of science students from the questionnaire shown in Table 4 reveal that 100% of the students either strongly disagreed or disagreed with statement 1, "*Physics tutor uses TLMs to teach physics regularly"*. All the students (100%) either disagreed or greed with statement 2 that"*there are no TLMs in the school physics laboratory"*. More than half of the students (90.0%) either disagreed and about 8.9% agreed with the statement, "*Physics tutor uses demonstration because materials are not available"*. About 86.8% agreed and 10.0% strongly agreed to statement 4 which is *tutors do not involve students in activities/practical work.* More than half of the students (64.4%) either disagreed and about 33.3% agreed with statement 5 that *our physics laboratory is well furnished with materials and equipment* which that shows students do not accepts that statement. From statement 6 showing a higher percentage of 64.5% agreed or strongly agreed by the students that *tutors allow students to prepare TLMs on their own for physics lessons.* Statement 7 shows that 95.6% of the students disagreed that *Physics tutors involve students in practical work using TLMs.* All the students (100%) either agreed or strongly agreed to statements 8 and 9 that the use of TLMs in learning physics helps students understand lessons. All the students (100%) either disagreed or strongly disagreed with statement 10 that "*Physics tutor uses TLMs to teach them",* implying that physics tutors in colleges of education are not fond of using TLMs to teach their lessons. All the students (100%) either agreed or strongly agreed with the statement "*the use of TLMs in physics help students to understand lessons taught"*. These responses from the students' shows an indication that students believed and accepted that their physics tutors are not fond of using

TLMs to teach them and also accepted that the use of TLMs helps them to understand lessons.

The subject can be seen as a technological discipline which students have suffered a lot from it over the years due to the fact that most tutors teach it without using TLMs. Shri (2013) state that TLMs in Science prove effective reinforcing agent by increasing the probability of the reoccurrence of the responses associated with learners. According to Deepak (2013; p.3), unless TLM is "*By the learners, for the learners & of the learners*" it does become just a decorative piece, nothing more. Shri (2013) again indicate that Teaching Learning Materials to the teachers and the learners aim to provide the necessary skills and knowledge along with the inculcation of proper interests and attitudes among them for the effective utilization of the audio-visual aid materials and equipment in the process of teaching and learning. This makes us to understand that whatever we see and do/practice, we understand and remember easily. However, the focus is on objective that when physics tutors use TLMs to teach, students have experience with materials and understand concepts better. This implies that physics tutors should always use TLMs in their teaching to engage learners in activities to see real materials and have firsthand experience with the materials, and this will motivate them to participate more during lessons to improve their performance.

Research Question 4: using learner-centred instructional approach and TLMs help in the improvement of students' performance in physics in colleges of education in Ghana?

Research question 4 was answered by the respondents using the statements of the questionnaire. The analysed questionnaire outcomes were done using percentages on the said concept discussed. The questionnaire responses are presented in the Table 5.

Table 5 Using learner-centred instructional approach and TLMs to help improve students' performance in physics in colleges of education in Ghana.

No	Statement	SD (%)	D (%)	N (%)	A (%)	SA (%)
1	Students enjoy learning physics when tutor centres the lesson among them	0(0)	0(0)	0(0)	68(75.6)	22(24.4)
2	Students enjoy physics lessons when tutor uses TLMs to teach	0(0)	0(0)	0(0)	71(78.9)	19(21.1)
3	Students participate well in class when tutor allows students to share ideas with the use of TLMs.	0(0)	0(0)	0(0)	67(74.4)	23(25.6)
4	Students perform better in physics class when tutors involve them in activities using TLMs	0(0)	0(0)	0(0)	76(84.4)	14(15.6)
5	Learning physics using TLMs makes it easy to understand physics concepts.	0(0)	0(0)	0(0)	59(65.6)	31(34.4)
6	Learning physics among colleagues encourage students to share ideas in class	0(0)	0(0)	0(0)	67(74.4)	23(25.6)
7	Learning physics among colleagues encourage students to increase their performance in class	0(0)	0(0)	0(0)	53(58.9)	37(41.1)
8	Tutor using learner-centred with TLMs to teach physics makes students active in class	0(0)	0(0)	0(0)	39(43.3)	51(56.7)
9	Physics practical/experiment helps students to make use of real materials to find solutions to problems.	0(0)	0(0)	0(0)	21(23.3)	69(76.7)
10	Learning physics in groups helps students to share ideas	0(0)	0(0)	0(0)	24(26.7)	66(73.3)
11	Learning physics in groups helps students to ask questions among ourselves	0(0)	0(0)	0(0)	13(14.4)	77(85.6)
12	Students perform better in physics class when tutors involve them in lessons.	0(0)	0(0)	0(0)	9(10.0)	81(90.0)

D (Strongly Disagree); D (Disagree); N (Neutral); A (Agree); and SA (Strongly Agree). Figures in bracket are in percentages.

Responses of the science students from the questionnaire shown in Table 5 reveal that all the students which constitute 100% who participated in the study agreed and strongly agreed to statements 1 to 12 that the use of TLMs and learner-centred approach in learning physics helps them to improve their performance in lessons. Students using TLMs to learn physics, which is interacting with materials to make enquiries, sharing ideas to co-operate with each other to find answers encourages them to participate in lessons. This focused on making learners active, contributing and performing activities in physics class using learner-centred teaching with TLMs. Erinosho, (2008) indicated that class activities, instructional content, and teaching method are selected to facilitate active learning, encourage independent thoughts and critical thinking, stimulate interest and promote positive attitude towards science. Erinosho (2008) again made assertion that student-centred lesson leads to better retention, better problem solving, better application of knowledge, and better motivation for further learning and an effective teacher is therefore able to adopt an eclectic approach to initiate quality science learning. Amos and Boohan (2002) suggested that practical work can provide a good opportunity for students to apply their newly acquired knowledge or skills and gain first-hand experience of phenomena talked about in theory.Oladejo, Olosunde, Ojebisi and Isola (2011) also suggested thatpoor achievement of student may not be separated from unavailability and inadequate use of TLMs for teaching, as well as instructional materials. This implies that physics tutors in colleges of education should teach their students using TLMs and learner-centredapproach which engages learners in activities and gives chance to learners to do their own learning without tutors interfering.This encourages learners to actively participate in lessons and improve their performance.

Tutors Respondents

Research Question 1: How does co-operative learning and enquiry encourage students' learning performance in science?

Research question 1 was answered with statements on questionnaire by physics tutors involved in the study. Table 6 shows responses of the questionnaire by selected physics tutors from the three colleges of education. The analysed questionnaire outcomes were done using percentages on the said concept discussed. The questionnaire responses are presented in the Tables 6.

Table 6: Encouraging students learning performance in science through co-operative and enquiry learning.

No	Statement	SD (%)	D (%)	N (%)	A (%)	SA (%)
1	Involving students in lessons helps them to participate in lessons	0(0)	0(0)	0(0)	2(66.7%)	1(33.3%)
2	Involving students in lessons encourage them to be active.	0(0)	0(0)	0(0)	1(33.3%)	2(66.7%)
3	Involving students in enquiry helps them to find solutions to problem themselves.	0(0)	0(0)	0(0)	2(66.7%)	1(33.3%)
4	Involving students in practical lessons encourage them to co-operate with colleagues in class.	0(0)	0(0)	0(0)	2(66.7%)	1(33.3%)
5	Students' participate well in lessons delivery when allowed to share ideas	0(0)	0(0)	0(0)	2(66.7%)	1(33.3%)
6	Involving students in groups encourages them to co-operate in sharing ideas.	0(0)	0(0)	0(0)	1(33.3%)	2(66.7%)
7	Involving students in practical lessons helps them to make enquiry.	0(0)	0(0)	0(0)	2(66.7%)	1(33.3%)
8	Students are able to ask questions when they learn together	0(0)	0(0)	0(0)	1(33.3%)	2(66.7%)
9	Students are active in class when making enquiry.	0(0)	0(0)	0(0)	2(66.7%)	1(33.3%)

SD – Strongly Disagree; D – Disagree; N – Neutral; A – Agree; SA – Strongly Agree. Figures in brackets are percentages'

Responses from the physics tutors from the questionnaire shown in Table 6 reveal that all the three tutors which constitute 100% who participated in the study agreed and strongly agreed with statements 1 to 9 that encouraging co-operative and enquiry learning by students helps them to increase their performances in science. The responses showed that physics tutors accepts that co-operative and enquiry learning promote active learning, participation, sharing of ideas among students during learning and finding solutions for themselves. Anderson and Helms (2001) believe that inquiry-oriented instructions are effective to student performance. Erinosho (2008) suggested enquiry promote scientific literacy and understanding of scientific processes, develop critical thinking and skills. Kim (2001) argues that knowledge is derived from interactions between people and their environments and resides within cultures. Joyce, Weil and Calhoun (2000a) also believed that co-operative learning can foster the development of deep understanding. All these indicate clearly that tutors believe that involving students in co-operative and enquiries during physics lessons encourage them to perform better.

Research Question 2: How will learner-centred instructional strategy be effective in encouraging participation in physics lessons in colleges of education?

Research question 2 was answered with statements on questionnaire by physics tutors involved in the study. The analysed questionnaire outcomes were done using percentages on the said concept discussed. The questionnaire responses are presented in Tables 7.

Table 7: Using learner-centred instructional strategy in encouraging studentsparticipation in physics lessons in colleges of education.

No	Statement	SD (%)	D (%)	N (%)	A (%)	SA (%)
1	Learner-centred approach is the best method to teach physics in colleges of education.	0(0)	0(0)	0(0)	1(33.3%)	2(66.7%)
2	Students are able to share ideas among themselves	0(0)	0(0)	0(0)	3(100%)	0(0)
3	Students participate well among themselves	0(0)	0(0)	0(0)	3(100%)	0(0)
4	Involving students much in physics lessons makes them active in class	0(0)	0(0)	0(0)	3(100%)	0(0)
5	Students ask questions in physics when lesson is centred on them	0(0)	0(0)	0(0)	3(100%)	0(0)
6	In learner-centred, students are allowed to share ideas together when tutors act as facilitator	0(0)	0(0)	0(0)	2(66.7%)	1(33.3%)
7	Students relate well with tutors when they are involve in physics lessons.	0(0)	0(0)	0(0)	0(0)	3(100%)
8	Students are able to find solutions for themselves when lesson is centred on them.	0(0)	0(0)	0(0)	1(33.3%)	2(66.7%)
9	Performance of students increases when lesson is centred on them and tutor acts as facilitator	0(0)	0(0)	0(0)	0(0)	3(100%)
10	Student's participation is very strong when learning is centred among them.	0(0)	0(0)	0(0)	2(66.7%)	1(33.3%)

SD – Strongly Disagree; D – Disagree; N – Neutral; A – Agree; SA – Strongly Agree. Figures in bracket are in percentage.

Responses from the physics tutors from the questionnaire shown in Table 7 reveal that all the three tutors which constitute 100% who participated in the study agreed and strongly agreed with statements 1 to 10 that using learner-centred approach for teaching physics in colleges of education helps students' performance in lessons. The responses show clearly that physics tutors accept the fact that when lessons are centred on students, it encourages their participations, makes them active in class, share ideas together, are able to relate well with their tutors when tutors act as facilitators and increase their performance. Learner-centered environment grows out of curricular decisions and in-class strategies which encourage students' interaction with the content, with one another and the teacher, and with the learning process. Stepanek (2000) proposed that there has been much emphasis on participatory classroom activities because there is a general agreement that effective learning requires students to be active in the learning process. Taras (2002) suggests that learner-centred learning has, in theory, promoted and brought about greater student participation and involvement. This indicates clearly that tutors strongly believe learner-centred teaching and learning encourages student(s) participation, promote activeness and increase learning performance.

Research Question 3: How effective do physics teachers use TLMs in teaching physics in the colleges of education?

Research question 3 was answered with statements on questionnaire by physics tutors involved in the study. The analysed questionnaire outcomes were done using percentages on the said concept discussed. The questionnaire responses are presented in the Tables 8.

Table 8: Physics tutors using TLMs to teach physics in colleges of education.

No	Statement	SD (%)	D (%)	N (%)	A (%)	SA (%)
1	I use TLMs to teach physics always	0(0)	3(100%)	0(0)	0(0)	0(0)
2	I use TLMs to teach if available	0(0)	2(66.7%)	0(0)	1(33.3%)	0(0)
3	I involve my students in practical lessons	0(0)	0(0)	1(33.3%)	2(66.7%)	0 (0)
4	Using TLMs to teach physics is a waste of time.	0(0)	3(100%)	0(0)	0(0)	0(0)
5	My school physics laboratory is furnished with TLMs and equipment	0(0)	2(66.7%)	0(0)	1(33.3%)	0(0)
6	My school laboratory does not have enough TLMs for teaching physics lessons	0(0)	1(33.3%)	0(0)	2(66.7%)	0(0)
7	Using TLMs to teach physics helps students to see real materials and participate well in lessons	0(0)	0(0)	0(0)	2(66.7%)	1(33.3%
8	Using TLMs to teach allows students to have a firsthand experience with most materials in class/laboratory	0(0)	0(0)	0(0)	0(0)	3(100%)
9	Using TLMs to teach my students makes them active in class.	0(0)	0(0)	0(0)	1(33.3%)	2(66.7%
10	Students perform better in physics lessons when TLMs are used in teaching.	0(0)	0(0)	0(0)	0(0)	3(100%)
11	Student's participation increases when they make use of TLMs in practical lessons	0(0)	0(0)	0(0)	2(66.7%)	1(33.3%

SD – Strongly Disagree; D – Disagree; N – Neutral; A – Agree; SA – Strongly Agree. The figures in bracket are in percentage.

Responses of the physics tutors from the questionnaire shown in Table 8 reveal that 100% of tutors disagreed with statement 1 that "*I use TLMs to teach physics always*". More than half of the tutors (66.7%) disagreed and 33.3% agreed with the statement, "*they use TLMs to teach if available*". About 66.7% agreed and 33.3% were neutral with the statement, "*I involve my students in practical lessons*". Less than half of the tutors (33.3%) disagreed and 66.7% agreed with the statement that "*my school laboratory does not have enough TLMs for teaching physics lessons*", which indicates that not all the colleges have well furnished physics laboratories. All the tutors (100%) either agreed or strongly agreed that using TLMs to teach physics lessons increase students' participation and performance in class. These responses show that most tutors in colleges of education do not use TLMs to teach their lessons. Teaching and learning materials (TLMs) are aids used by the teacher to teach effectively and for learners to learn effectively. Shri (2013) argues that Teaching Learning Materials to the teachers and the learners aim to provide the necessary skills and knowledge along with the inculcation of proper interests and attitudes among them for the effective utilization of the audio-visual aid materials and equipment in the process of teaching and learning According to Shri (2013) again, TLMs in Science prove effective reinforcing agent by increasing the probability of the reoccurrence of the responses associated with learners . In this context, the duty of physics tutors is to provide appropriate environment where the student will construct his/her knowledge by interacting with materials and equipment. This implies that physics tutors must always use TLMs to teach students to have experience with materials to increase their performances.

Research Question 4: Will the use of learner-centred instructional approach and TLMs help in the improvement of students' performance in physics in colleges of education in Ghana?

Research question 4 was answered with statements on questionnaire by physics tutors involved in the study. The analysed questionnaire outcomes were done using percentages on the said concept discussed. The questionnaire responses are presented in Table 9.

Table 9: Using learner-centred instructional approach and TLMs to help improve students' performance in physics in colleges of education in Ghana.

No	Statement	SD (%)	D (%)	N (%)	A (%)	SA (%)
1	Students grouped for discussion in physics lessons helps them to share ideas together	0(0)	0(0)	0(0)	3(100%)	0(0)
2	Students participation in physics lessons helps them to find solutions for themselves during practical	0(0)	0(0)	0(0)	3(100%)	0(0)
3	Students using appropriate TLMs for physics improves their participation in class	0(0)	0(0)	0(0)	1(33.3%)	2(66.7%)
4	Students using TLMs for learning physics lessons gives them easy understanding of difficult concepts	0(0)	0(0)	0(0)	3(100%)	3(100%)
5	Using appropriate TLMs to teach physics lessons increases students' interest in class	0(0)	0(0)	0(0)	3(100%)	0(0)
6	Students using TLMs in physics lessons improve their performance in class	0(0)	0(0)	0(0)	0(0)	3(100%)
7	Students are motivated to participate in physics lessons when lesson is centred on them with tutor acting as facilitator	0(0)	0(0)	0(0)	3(100%)	0(0)
8	Students give better solutions to problems when allowed to share ideas in class	0(0)	0(0)	0(0)	3(100%)	0(0)
9	Students' interest in physics increases when they are responsible for learning	0(0)	0(0)	0(0)	3(100%)	0(0)
10	Students are motivated to participate well in class when they are responsible for learning	0(0)	0(0)	0(0)	3(100%)	0(0)

SD – Strongly Disagree; D – Disagree; N – Neutral; A – Agree; SA – Strongly Agree. Figures in bracket are in percentage.

Responses of the physics tutors from the questionnaire shown in Table 9 reveal that all the tutors constituting 100% who participated in the study agreed and strongly agreed with statements 1 to 10 that the use of TLMs and learner-centred approach in teaching physics helps students to improve their performance in lessons. Responses from physics tutors shows that making students responsible for learning with the use of real TLMs through practical lessons motivate learners to participate actively, understand lessons easily, increase students' interest and improve their performances in class. Erinosho (2008) made assertion that student-centred lesson leads to better retention, better problem solving, better application of knowledge, and better motivation for further learning and an effective teacher is therefore able to adopt an eclectic approach to initiate quality science learning. Physics is an experimental subject and the teaching and learning of it needs a lot of teaching learning materials (TLMs). Amos and Boohan (2002) suggested that practical work can provide a good opportunity for students to apply their newly acquired knowledge or skills and gain first-hand experience of phenomena talked about in theory. This implies that the use of learner-centred teaching with TLMs will improve performance of students if physics tutors adopt them in their teaching.

4.2 Observational Checklist

The main objective of this section is to establish whethere effects of TLMs and learner-centred aproach will improve second year science students' performance in physics in Colleges of Education in Ghana. Observational checklist of 20 items were used to observe both physics tutors and science students' behaviour in the three selected Colleges of Education for the study using the TLMs and learner-centred approach to teach on the topic "heat energy". While observing physics tutors and science students during the lessons, some of the students and the selected physics tutors were interviewed. To ascertain whether there was consistency, outcomes from the observational checklist were cross-checked with the responses giving by science students and physics tutors from their interview. Thus, for clasifications of ratings given, the checklist was ticked based on what was observed and documented. The checklist hasAgree (A), Uncertain (U), Disagree (D) responses which the researcher used to tick the appropriate response.

For observational checklist to be in line with effects of TLMs and learner-centre aproach it was based on the scope of a number of scholars. The checklist was created by the researcher to suit the nature of the research. The use of learner-centred approach of teaching physics was modified from Elen, Clarebout, Leonard and Lowyck (2007), Anderson (2008) on constructivist views. The ratings given are shown in frequency and Percentages in Table 10 below.

Table 10 Observation of second year science students and physics tutors during physics lesson on the topic "heat energy".

No	Observational Checklist	A (%)	U (%)	D (%)
1	All TLMs needed for the lessons were presented in the laboratory.	3(100%)	0(0)	0(0)
2	Some of the TLMs presented were improvised	2(66.7%)	0(0)	1(33.3%)
3	The lesson was centred on students.	3(100%)	0(0)	0(0)
4	Lesson presentation focuses on the use of learner-centred teaching and TLMs in teaching physics.	3(100%)	0(0)	0(0)
5	Tutor allows students to use TLMs to perform experiment.	2(66.7%)	0(0)	0(0)
6	Tutor arranges students into groups for the lesson because TLMs were not enough	0(0)	1(33.3%)	2(66.7%)
7	Students giving instructions to follow to perform experiments.	2(66.7%)	1(33.3%)	0(0)
8	Students work with the TLMs to make enquiries.	3(100%)	0(0)	0(0)
9	Students co-operate with each other in the groups to find solutions to problem.	3(100%)	0(0)	0(0)
10	Students discuss with each other to work with materials.	3(100%)	0(0)	0(0)
11	Students asked question from each other in groups to share ideas.	3(100%)	0(0)	0(0)
12	Students asked questions from tutor when having difficulties.	2(66.7%)	1(33.3%)	0(0)
13	Tutor act as facilitator and co-learner during lesson.	3(100%)	0(0)	0(0)
14	Members in groups actively participating in lesson.	3(100%)	0(0)	0(0)
15	Students were happy doing their own learning.	3(100%)	0(0)	0(0)
16	Learners were happy working with real and appropriate TLMs.	3(100%)	0(0)	0(0)
17	Learners were encouraged during lesson.	3(100%)	0(0)	0(0)
18	Learners were interested in working with TLMs.	3(100%)	0(0)	0(0)
19	Learners' performance is increased during the lesson.	3(100%)	0(0)	0(0)
20	Learners were able to find solutions to problem and bring out new ideas.	3(100%)	0(0)	0(0)

Agree (A), Uncertain (U), Disagree (D). Figures in bracket are in percentage

From the observations made and interview conducted by the researcher from the three colleges, it was found that materials needed for the lessons were provided in the laboratory. Interviews conducted for some students in the three colleges confirmed that all thetutors brought the necessary materials needed for the experiment and the laboratory was set up with the materials for the practical work. Physics tutors interviewed also confirmed that they provided all the necessary materials in the laboratory needed for the lesson. This implies that there is consistency between the checklist and the interview responses from tutors and students.

It was observed that 100% of the lessons were centred on students and tutors acted as facilitators and co-learners. The responses from students say that 'tutors allowed them to do their own learning by performing the experiments themselves; they said they were able to find solutions to the problem'. Response from tutors' interview showed that 'tutors gave instructions to students and acted as facilitators during the lessons; students were able to make their own enquiries and find solutions to the problem'.This confirmed that lessons were centred on the learners and tutors only acted as facilitators. This shows consistency between the checklist and the interview responses from tutors and students. Abell and Lederman (2007) proposed that effective learning requires students to be active in the learning process. Anderson et al. (2006) proposed that learner-centred teachers articulate what we expect our students to learn, design educational experiences to advance their learning, and provide opportunities for them to demonstrate their success in achieving those expectations.

It was observed that all the students (100%) worked with TLMs during the lesson and co-operated with each other in their groups. Responses from the students' interview indicated that all the students in groups actively worked with the TLMs to find answers and they co-operated with each other through questions to share ideas together; learners said they were happy and interested in working with the TLMs to find solution. Tutors' responses also indicated that learners worked actively with the TLMs and co-operated with one another in their groups to find answers; they said learners were much interested to see the outcome of the experiment and they all participated well in the lesson. This confirmed that students worked with TLMs and co-operated with each other in a groups to find solutions. This indicated that there is consistency between the observational checklist and the interview responses from tutors and students. Cimer (2007) suggested that in order to foster cognitive conflict, students need opportunities to pose questions about science, to work with others, to conduct investigations, present and defend their ideas, solutions, and findings, and assess their own and other students' reasoning.

It was also observed that 100% of the students actively participated in the lesson, they were encouraged, interested in the lesson, able to find solutions to the problem and find new ideas. Reponses from the students' interview indicated that students involved themselves in the lesson to perform experiment and they were able to find the answers they needed and new ideas too were found during the lessons, and students became much interested in the lesson. Responses from physics tutors also indicated that during the practical lesson, learners participated well, students found solutions to the problem through making enquiries; some were able to find new ideas; students' interest were raised and were much encouraged to work with themselves using the TLMs. These responses also confirmed that learners were encouraged and interested in the lesson of which they were able to find new ideas by themselves when working together with TLMs.This implies that there is consistency between the observational checklist and the interview responses from tutors and students. Cimer

(2007) indicates that learners do not construct knowledge in isolation but through social interaction with their peers and thus, the interactions among learners affect each other's learning. Cimer (2007) again suggested that peer-peer discussions in co-operative learning groups can promote meaningful learning by helping learners to help each other to incorporate new experiences and information into their existing cognitive structures in a non-arbitrary and non-verbatim way.

4.3 Perspectives across the Colleges of Education

This section focused on the main issues common to all the three colleges of education pertaining to the use of TLMs and Learner-centred approach in teaching physics. Based on the data presented in this chapter, it was observed that most tutors in colleges of education do not use TLMs and learner-centred approach to teach physics regularly even when necessary.

During the period of study, the data collected from students showed that colleges of education physics tutors are fond of using lecture method to teach their lessons. Physics tutors do not use TLMs to teach their lessons to involve students in practical work, always making students the listeners but not participants in lessons. It was evident that some of the colleges do not have enough TLMs to teach lessons; most materials found in their physics laboratories were outmoded and cannot be used.

The responses of the questionnaire also revealed that, some physics tutors sometimes improvised TLMs during lessons. These improvise materials are mainly produced using locally available materials. Example spring balance, beam balance, beakers, stops watch and more. This could be reason why some of the tutors in the colleges were unable to teach with TLMs because they said improvising is time consuming. The non availability of some TLMs was also factors that affected the use TLMs by physics tutors.

Observational checklist was used to check if there will be consistency with the interview response from science students and physics tutors. From the analyses made from Table 10 implies that learners fully participated during the lesson, their performance were increased, approach used by the tutors encouraged students participation a lot in the lesson and there were consistency with interview responses from students and tutors.

It was also observed that during the lesson conducted for the study, some of the colleges do not have all the real and appropriate materials needed for the lesson, so these were improvised and used for the lesson. Students participated well in the lessons, lessons were centred on them, worked with the materials, co-operated with each other, made enquiries, shared ideas, contributed well and brought out new ideas for themselves. These imply that there were positive effects on students when physics tutors used TLMs and learner-centred approach to teach their lessons.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

This chapter deals with the summary of the study. Also, it takes care of the conclusions drawn from the study; recommendations made from the findings and suggested areas for further research.

5.1 Summary

This research was designed to verify the effects of the use of TLMs and learner-centred approach on students' performance in the learning of physics in the colleges of education in Ghana. The researcher used both quantitative and qualitative survey (mixed method) design for this study. Three (3) of the colleges of education from the southern part of Ghana out of the 15 Science Colleges of Education were sampled namely: Foso College and Komenda College in central Region and SefwiWiawso College in Western Region of Ghana, including one of their physics tutors who teach them physics were sampled for the study.

The respondents comprised all science students studying physics and tutors teaching physics in the three selected science colleges of education. The researcher chose the second year students because they had treated almost all major topics in physics. The selected sampled students were observed, interviewed and answered questionnaires for the analysis. The purposive sampling technique was employed by the researcher because the researcher's place of work and home are both close to the selected regions. The researcher purposively selected the subjects to include only second year science students because they offer physics as one of their major courses which is the purpose of the research.

Students and tutors were purposively selected using the homogeneous purposive sampling for the research. Homogeneous sampling is a purposive sampling technique that aims to achieve a homogeneous sample; that is, a sample whose units share the same (or very similar) characteristics ortraits**.** Purposive homogeneous sampling was used to select students from each of the schools because the students are science students who study physics as one of their major courses in science with the same course outline.

Data concerning the use of learner-centred approach and TLMs to teach physics were collected using questionnaire, interview and observational checklist. The study collected both quantitative and qualitative data to answer the four main research questions. For each question both qualitative and quantitative data were analysed separately and merged during the interpretation of findings in order to gain an in-depth understanding. The questionnaire responses were anlysed using the SPSS. The interviews were analysed using content analysis. The classroom observational checklists were analysed using classroom behaviour of the students.

The following are the summary based on the four (4) Research Questions:

The use of learner-centred approach and TLM in teaching has proved to be very important in facilitating the teaching and learning process. As the tutors use learner-centred approach in teaching where learning is centred on students with the use of TLMs for learning mostly practical activities, they are at the same time acting as role models to the student teachers, who will in turn copy the practice and use learner-centred approach and TLMs during teaching practice and in their own practice after completing college.

Despite the use of learner-centred approach and TLMs having a positive impact on the teaching and learning physics, data in this study have exposed that physics tutors in science colleges of education use lecture method in their teaching. This finding clearly shows that physics tutors are more of lecturing while student teachers listen.

Research question 1 was on how co-operative learning and inquiry encourage students' learning performance in science. The results of the study indicated that:

i. Students learning together in groups encourage them to share ideas.
ii. Students' learning through performing activities makes them active in class and helps them find solutions to problems themselves.

Research question 2 was on how learner-centred instructional strategy is effective in encouraging student(s) participation in physics lessons in colleges of education. Result of the analysis shows that when lessons are centred on students and tutor acts as a facilitator by guiding the students what to do, students are much involved in the lesson, participation becomes encouraging and students are motivated to find answers to problems.

Research question 3 focused on how effective physics teachers use TLMs in teaching physics in the colleges of education. Respondents indicate that:

i. Physics tutors do not use TLMs in their lessons and most of them are fond of using lecturing method in their teaching.

ii. Some of the colleges do not have well furnished laboratories and the appropriate TLMs to teach specific topics.

iii. The use of TLMs in teaching and learning physics help students to understand lessons better.

Research question 4 concerned whether the use of learner-centred instructional approach and TLMs help in the improvement of students' performance in physics in colleges of education in Ghana. The analysis showed that:

i. The use of learner-centred approach and TLMs in teaching makes students more active in class and the performance increased.

ii. Students working together always seek ideas to learn from each other that improved their learning skills.

iii. Tutors find it easier in their teaching because learners did most of the learning with tutor acting as a facilitator.

iv. Students doing most of the learning by performing activities with TLMs got firsthand experiences and increased their interest in physics.

5.2 Conclusion

This study was to provide a description of the use of learner-centred approach and TLMs in teaching physics in Colleges of Education in Ghana. This study attempted to define the reasons for inclusion of learner-centred teaching and TLMs by tutors in their instruction in the selected colleges. The research into the utilization of learner-centred approach and TLMs by physics tutors had revealed the competencies and trend in the usage of these methods and TLMs by tutors. Despite the use of learner-centred approach and TLMs having positive effects on the teaching and learning process, data in this study have exposed that physics tutors in the colleges of education use more of the lecture method in their teaching than any other method/approach. The study also found that, physics tutors do not use TLMs for teaching students by involving them in activities/experiment in all the three colleges.

The use of Learner-centred teaching and TLMs perform such functions as the extension of the range of experience available to learners, supplement and complement the tutor's verbal explanations thereby making learning experience richer and providing the tutor with interest into a wide variety of learning activities. TLMs supplement, clarify, vitalize, emphasize instruction and enhance learning in the process of transmitting knowledge, ideas, skills and attitude. Learner-centred encourage students to construct their own meaning by talking, listening, making enquiries, writing, reading, and reflecting on content, ideas, issues and concerns. It was recognized that students learn in different ways and have different learning styles and personalised/individualised responses were encouraged. This calls for tutor(s) resourcefulness and method of teaching on the part of the Physics tutors.

There is therefore the need to involve the students in more learner-centred activities with the use of TLMs. Students should disabuse their minds that physics is difficult and that physics is abstract and difficult to understand. The ability of the tutor to make use of TLMs and learner-centred approach in teaching makes lesson more effective and improve students' achievement and performance.

5.3 Recommendations

Recommendations of a research study are generally made from the findings of the study. Therefore, the recommendations offered are directly related to the findings of this study. The findings from research question four (4) were those that seemed to be adverse and need more attention. On the basis of the findings of this study and conclusions reached, the following recommendations were made:

i. It was found that tutors are fond of using lecturing approach for teaching physics. Owing to that, it is suggested that all physics tutors in colleges of education should be encourage to use learner-centred approach and TLMs to teach physics.

ii. It was seen that attitude of physics students did not help in the learning of physics. Based on this, it is recommended that science colleges of education counselors should admonish physics students to have positive attitude towards the study of physics so that as they progress on the educational ladder, they would appreciate the need to learn physics.

iii. Colleges of education should endeavour to provide TLMs for teaching physics to make the study of physics more interesting and practical.

5.4 Areas for further research

The result of the current studysuggested a number of directions for further study.Firstly, there is the need to conduct a study on the impact of using leaner-centred approach and TLMs in teaching physics in the colleges of education as the availability and usage of these learner-centred approach and TLM are not in isolation

A research can also be conducted in comparing the availability and usage of TLMs and learner-centred approach in teaching science in Science and Non-Science Colleges of Education as the Non-Science Colleges are also teaching Integrated Science. The use of scholarship for physics students as incentive to study physics at the secondary and tertiary education levels.

REFERENCES

Abell, S.K. & Lederman, N.G. (Eds.) (2007). *Handbook of research on science education*. Mahwah, N.J: Lawrence Earlbaun.

Adesoji, F. A. (2008). Managing students' attitude towards science through problem–solving instructional strategy, *Anthropologist*, *10*(1), 21-24.

Adeyemo, S. (2010). Teaching/learning physics in Nigerian secondary school: The curriculum transformation, issues, problems and prospects. *International Journal of Educational Research and Technology, 1*(1), 99-111.

Adu-Gyamfi, K. (2013). Using the activity method to enhance students' performance in energy transformation. *International Journal of Research Studies in Educational Technology*, *3*(1), 87-97

Agina-Obu, T. N. (2005). The relevance of instructional materials in teaching and learning.In I. Robert-Okah& K. C.Uzoeshi, (Eds).*Theories and practice of teaching*.Port Harcourt: Harey Publication.

Aina, J. K.,&Akintunde, Z. T. (2013).Arhin, F.S.A &Asimah, G. (2004).*Methods of teaching integrated science for training colleges.* Accra: Teacher Education Division.

Aiyelabegan, T. A. (2003). Effect of physics practical on students' academic performance in senior school certificate examination in Kwarastate.*Lafiagi.Journal of Science Education.1*(2), 34.

Akanbi, A.O. (2003). An investigation into students' performance in senior secondary school physics.*Journal of Teacher education trends.1*(1), 58-64.

American Association for the Advancement of Science (AAAS), (1990). *Effective learning and teaching:Principles of learning of teaching science, mathematics, and technology*. Retrieved from*www.project2061.org/publications/sfaa/online/chap13.htm*

Amos, S. (2002). Teachers' questions in the science classroom. In S. Amos & R. Boohan (Eds). *Aspects of teaching secondary science* (pp 5-15). Routledge Falmer: London.

Amos, S. &Boohan, R. (2002).*Aspects of teaching secondary science*.RoutledgeFalmer: London.

Anderson, R. D.,& Helms, J. V. (2001).The ideal of standards and the reality of schools: Needed research.*Journal of Research in Science Teaching*, *38*(1), 3-16.

Anderson, L., Balsamo, A., Bucher, S., Carnicke, S., Chrystal, S., Fliegel, R., Garner,J., &Hollins, E. (2006*). Learner-centered teaching and education at USC: A resource for faculty*.Carolina: University of South Carolina.

Anderson, T. (2008).The theory and practice of online learning.Athabasca: Athabasca University Press.

Anderson. L., Balsamo. A., Bucher. S.,Carnicke.S.,&Chrystal.S. (2006).*Learner-centered teaching and education at USC*: *A resource for faculty*. Carolina: University of South Carolina.

Arhin, F.S.A.,&Asimah, G. (2004).*Methods of teaching integrated science for training colleges.* Accra:Teacher Education Division.

Ary, D., Jacobs, L. C., &Razavieh, A. (2002).*Introduction to research in education*(6thed). Belmont, CA: Wadsworths.

Besty, L.N. (2012).The application of community service learning in science education.*Asia- Pacific Forum on Science Learning and Teaching*,*13*(2),1-15.

Boohan, R. (2002). ICT And Communication. In S. Amos and R. Boohan (eds). *Aspects of teaching secondary science: Perspectives on practice*. London: RoutledgeFalmer.

Brown J. K. (2008). Student-centered instruction: Involving students in their own education. *Music Educators Journal*, *94*, 30–35.

Brown, K. (2014). *Our shrinking world*. Oregon: University of Oregon.

Bryman, A. (2008). *Social research methods.*(3rded.). New York: Oxford University Press.

Buabeng, I., &Ntow, D. F. (2010). A Comparison study of students' reasons/views for choosing/not choosing physics between undergraduate female non-physics and female physics students at University of Cape Coast. *International Journal of Research in Education, 2*(2), 44-53.

Buabeng, I.,Ossei-Anto, T. A., &Ampiah, J. G. (2014). An investigation into physics teaching in senior high schools.*World Journal of Education,4* (5), 40-43.

Center for Continuing Education (2005). *Introduction to educational research*. Cape Coast:University of Cape Coast, Ghana.

Cheng,F. (2016).*Society has prime impact on science*. Retrieved from *http://www.straitstimes.com/forum/letters-in-print/society-has-prime-impact-on-science.*

Chin, C., &Brown,D.E. (2000). Learning in science: A comparison of deep and surface approaches. *Journal of Research in Science Teaching,37*(2), 109–138.

Cimer, A. (2007). Effective teaching in science: A review of literature. *Journal of Turkish Science Education,4* (1), 20-24.

Cohen, L., Manion, L., &Morrison, K. (2007). *Research methods in education*(5th ed). New York: Routledge Falmer.

Craker, D. E. (2006). Attitudes toward science of students enrolled in introductory level science courses at UW-La Crosse,*Journal of Undergraduate Research IX*, 1-6.

Creswell, J. W. (2002*). Educational research, planning, condaucting and evaluating qualitative and quantitative research.*New York: Pearson Merrill PrenticeHall.

Creswell, J., & Plano Clark, V. (2006). *Designing and conducting mixed methodsresearch*. New York: McGraw-Hill.

Creswell, J.W. (2007). Research design: Qualitative, quantitative, and mixed methods approach. (3rded.). London: Sage.

Creswell, J. W. & Planoclark. V. (2007). *Desigingning and conducting mixed methods research.* London: Sage.

Curriculum Research and Development Division [CRDD]. (2008). *Teaching syllabus for physics (Senior High School).* Accra: Ghana Education Service.

Curriculum Research and Development Division (CRDD) (2010).*Integrated science syllabus for senior high schools*.Accra: Ministry of Education.

Dawe, S. (2003).*Practical work*: *The universal panacea*? Retrieved from http://www.bishops.ntc.nf.ca/rriche/ed6620/practical.html

Deboer, G.E. (2002). Student-centred teaching in a standards-based world: Finding a sensible balance. *Science & Education, 11,* 405-417.

Deepak, D. (2013).*Effective teaching learning materials.*Retrieved from

file:*///C:/Users/ACER/Desktop/CITATION/DEEPAK%20DIXIT%202013.htm*.

Dewey, J. (1938). *Experience and education*. New York: Macmillan.

Elen, J., G. Clarebout, R. Leonard, & J. Lowyck. (2007). Student-centred and teacher-centred learning environments: What students think. *Teaching in Higher Education, 12*(1), 105–117.

Erdemir, N. (2004). *An identification of physics student teachers' changing of successes and attitudes in their education processes*, Unpublished Ph.D Thesis, Blacksea Technical University, Trabzon.

Ergul, R., Simsekli, Y., Calis, S., Ozdilek, Z., Gocmencelebi, S., &Sanli, M. (2011). The effects of inquiry-based science teaching on elementary school students' science process skills and science attitudes.*Bulgarian Journal of Science and Education Policy*,*5*(1), 48-68.

Erinosho, S. Y. (2002). Linking school science and indigenous science: A science performance improvement programme. A Research Report Submitted to AFCLIST, Durban, South Africa.

Erinosho, S. Y. (2008). *Teaching science in secondary schools: A methodology handbook.*Lagos: African Cultural Institute.

Erol, M., Selcuk, G. S. &Calıskan, S. (2006). Evaluation of problem solving behaviours of physics teacher candidates, *Journal of Education*, *30*, 73-81.

Fosnot, C. T. (2005). Preface. In C. T. Fosnot (Ed.), *Constructivism: Theory, perspectives and practice*(2nd ed.). New York: Teachers College Press.

Glenn, R. E. (2001). What teachers need to be. *The Education Digest*. *67*(1), 19-21.

Gobert, J.D., & Pallant, A. (2004). Fostering students' epistemologies of models via authentic model-based tasks. *Journal of Science Education and Technology*. *13*(1), 7-22.

Gonen, S.,&Basaran, B. (2008). The new method of problem solving in physics education by using scorm-compliant content package, *Turkish Online Journal of Distance Education,9*(3), 112-120.

Gray, D. E. (2009). *Doing research in the real world*(2ndEd.) London: Sage.

Greene, J. C. (2007). *Mixed methods in social inquiry*. Washington DC: Jossey-Bass.

Hipkins, R.., Bolstad, R.., Baker, R.., Jones, A., Barker, M.., Bell, B., Coll, R.., Cooper, B., Forret, M., France, B., Haigh, M., Harlow, A.,& Taylor, I. (2002). *Curriculum, learning and effective pedagogy: A literature review in science education*. Wellington: Ministry of Education.

Hoadley, C. M. (2004). Methodological alignment in design-based research. *Educational Psychologist,39* (4), 203-212.

Hwang, F., and Esquembre, F. (2003).Easy Java simulations: An interactive science learning tool, interactive multimedia electronic. *Journal of Computer-Enhanced Learning*.5(2).

Institute of Education, Chief Examiner's Report: Physics, (2009). Awards Committee Meeting, University of Cape Coast. (August 2009)

Institute of Education, Chief Examiner's Report: Science Methods, (2006). Awards Committee Meeting, University of Cape Coast. (August 2006)

Isola, O.M. (2010).*Effects of standardized and improvised instructional materials students' academic achievements in seconadry school physics.*Published M.Ed Thesis, University of Ibadan, Ibadan.

Jeanpierre, B, Oberhauser, K.,&Freeman, C. (2005). Characteristics of professional development that effect changes in secondary science teachers classroom practice. *Journal of Research in Science Teaching,42*(6), 668-690.

Jegede, O.J., Okota, O.E. &Eniayeju,P.A. (2010).Raising the standard of performance in public examination in science, technology and mathematics.STAN Position Paper No. 4.

Jones, M.G. & Carter, G. (1998). Small groups and shared constructions.In J.J., Mintzes, J.H Wandersee and J. D. Novak (eds). *Teaching science for understanding: A human constructivist view*(pp 261-278). San Diego, CA: Academic Press.

Joppe, M. (2000). *The research process*. Retrieved from http://www.ryerson.ca/~mjoppe/rp.htm.

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

Joyce, B., Calhoun, E., & Hopkins, D. (2000b). *Models of learning - tools for teaching*. Buckingham: Open University Press.

Khan, M.., & Iqbal, M. Z. (2011). Effect of inquiry lab teaching method on the development of scientific skills through the teaching of Biology in Pakistan. Language in India. *Strength for Today and Bright Hope for Tomorrow*, *11*, 169-178.

Kim, B. (2001). Social constructivism. In M. Orey (Ed.), *Emerging perspectives on learning, teaching,andtechnology*. Retrieved from*http://www.coe.uga.edu/epltt/SocialConstructivism.htm.*

Kozlowski, S. W. J., Toney, R. J., Mullins, M. E., Weissbein, D. A., Brown, K. G., & Bell, B. S. (2001). Developing adaptability: A theory for the design of integrated-embedded training systems.In E. Salas (Ed.), *Human/technology interaction in complex systems* (Vol. 10). Cincinnati: Greenwich.

Leedy, P. D.(1989). *Practical research: Planning and design*(4thEd). New York: Macmillan Publishing Company.

Mattern, N.,&Schau, C. (2002).Gender difference in attitude-achievement relationships over time among white middle-school students.*Journal of Research in Science Teaching*, *39*(4), 324-340.

Mayer, R. E. (2004). Should there be a three-strikes rule against pure discovery learning? The case for guided methods of instruction.*American Psychologist, 59,* 14-19.

McBride, J. W., Bhatti, M. I., Hannan, M. A., & Feinberg, M. (2004). Using an inquiry approach to teach science to secondary school science teachers. *Physics Education*, *39*(5), 1-6.

McSharry, G. & Jones, S. (2000). Role-play in science teaching and learning. *School Science Review*,*82*(298),73-82.

Miller, E., (2012). *Applying principles of conversation analysis to the facilitation of student-participation in classroom discussions*. Retrieved fromwww.storytellingandvideoconferencing.com .

Muller, D.A. (2008).*Designing effective multimedia for physics education*. Sydney: School of Physics, University of Sydney.

National Research Council (NRC) (1989).*High-School biology today and tomorrow*.Washington DC: National Academy Press.

National Science Teachers Association (NSTA) (2009), *Thebiology teacher's handbook.*New York: NSTA Press.

Normah.Y.,&Salleh, I. (2006).Problem solving skills in probability among matriculation students. Paper presented at National Educational Research Seminar XIII, 40-55.

Ogunleye, A.O., (2000). Towards the optimal utilization and management of resources for the effective teaching and learning of physics in schools.Proceedings of the 41st Annual Conference of the Science Teachers Association of Nigeria.University of Lagos.

Oladejo, M.A, Olosunde,G.R., Ojebisi,A.O., &Isola,O.M. (2011). Instructional materials and students' academic achievement in physics: some policy implications. *European Journal of Humanities and Social Sciences*, *2*(1).

Orleans, A. V. (2007). The condition of secondary school physics education in the Philippines: Recent developments and remaining challenges for substantive improvements. *The Australian Educational Researcher*, *34*(1), 33-54.

Osokoya, I. O. (2007). Effects of video-taped instruction on secondary school students' achievement in history. *International Journal of African & African American Studies*, *6*(1), 27-34.

Ottevanger, W., Van Den Akker, J.,&Feiter, L. D. (2005).Developing science, mathematics and ICT (SMICT) in secondary education: Patterns and promising practices. African Region Human Development Working Paper series (SEIA) thematic study report No. 7 Sept. 2005.

Ouellette, R.P. (2004). *The challenges of distributed learning as new paradigm for teaching and learning*. College Park: University of Maryland College.

Owolabi, T., (2004).A diagnosis of students' difficulties in physics.*Educational Perspectives*, *7*, 15-20.

Peat, M. & Fernandez, A. (2000). The role of information technology in biology education: An Australianperspective. *Journal of Biological Education, 34*(2), 69-73.

Pies, W. R., (2010).*Psychiatry remains a science, whether or not you like.*Retrieved from http://www.psychiatrictimes.com/bipolar-disorder/psychiatry-remains-science-whether-or-not-you-dsm5.

Quarcoo-Nelson, R., Buabeng, I., & Osafo, D. K. (2012).Impact of audio-visual aids on senior high school students' achievement in physics. *Eurasian Journal of Physics and Chemistry Education,4*(1), 46-54.

Rivard L. P.,& Straw, S. P. (2000). The effect of talk and writing on learning science: An exploratory study. *Science Education*, *84,* 566-593.

Saunders, M., Lewis, P.,&Thornhill, A. (2000).*Research methods for business sensitive pedagogy.* Ontario: University of Western Ontario.

Schumann**,** G. L. (2002). Enhanced learning through role-playing. Massachusetts: University of Massachusetts.

Schweisfurth, M. (2011). Learner-centred education in developing country contexts: From solution to problem? *International Journal of Educational Development*, *31*, 425-432.

Shri, K. M. (2013). Use of teaching learning materials in science at upper primary school in MandleshwarKhargone, (Madhya Pradesh): An Analysis. *International Journal of Scientific and Engineering Research*.*4*(2).

Sunal, W.D. (2004).*Learning meaning through conceptual reconstruction-a learning/teaching strategy for secondary students*.Alabama: University of Alabama.

Taras, M. (2002). Using assessment for learning and learning from assessment. *Assessment and Evaluation in Higher Education*, *27*(6),501-510.

Tashakkori, A.,& Teddlie, C. (Eds) (2003). *Handbook of mixed methods in social and behavioural research*. Thousand Oaks, CA: Sage.

Teacher Education Division.(2006). *Methods of teaching integrated science for college of education.*Accra: Teacher Education Division.

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

Trowbridge, L. W., Bybee, R., W.,& Powell, J. C. (2004). *Teaching secondary school science*: Strategies for developing scientific literacy. Thousand Oaks: Person Prentice Hall.

Von Glasersfeld, E. (2005). Introduction: Aspects of constructivism. In C. T. Fosnot (Ed.), *Constructivism: Theory, perspectives and practice* (2nd ed.) (pp.3-7). New York:Teachers College Press.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*, Cambridge: Harvard University Press.

Wambugu, P. W., & Changeiywo, J. M. (2008). Effects of mastery learning approach on secondary school students' physics achievement. *Eurasia Journal of Mathematics, Science & Technology Education,4*(3), 293-302.

Weimer, M. (2002).*Learner-centered teaching*: *Five key changes to practice*. San Francisco: Jossey-Bass.

Woods, D. R. (1995). Teaching and learning: What can research tell us? *Journalof College Science Teaching, 25,* 229-232.

Zemsky, R.., Gregory, Wegner, R..,& William, F. M. (2005). *Learner-centered teaching*. Southern Califonia: Rutgers University Press.

APPENDICES

APPENDIX A

Effects of TLMs and Learner-Centred approach on students′ Performance in Physics in some selected Colleges of Education in Ghana.

QUESTIONNAIRES FOR STUDENTS

Section A

1. Name of College……………………………………………………………

Please tick [√] the appropriate respond below.

2. Gender: Male [ ] Female [ ]

Section B

This questionnaire is designed to investigate how co-operative learning and enquiry encourage students' learning performance in science. The researcher really appreciates your cooperation and participation.

Instruction: To respond to this questionnaire, please put a check mark (√) in the appropriate box to indicate your level of agreement or disagreement with the statements:

SD (**Strongly Disagree**); D (**Disagree**); N (**Neutral**); A (**Agree**); and SA (**Strongly Agree**)

Research Question 1

How does co-operative learning and enquiry encourage students learning performance in science?

No	Statement	SD (%)	D (%)	N (%)	A (%)	SA (%)
1	Learning physics alone in class is difficult for me					
2	Learning physics in groups help me to share ideas with friends.					
3	Physics lessons are understood when tutor uses lecturing method					
4	Physics lessons are understood when tutor involves students in activities					
5	Making enquiry in physics lessons encourage students to participate					
6	Sharing ideas with friends during physics lessons encourage students to participate effectively					
7	Learning in groups in class brings about co-operative learning					
8	Discussion as in Co-operative learning helps students to share ideas together.					
9	Brainstorming as in Co-operative learning helps students to perform better in class.					
10	Making enquiries as in co-operative learning encourages students to find solutions for themselves					

No	Statement	SD (%)	D (%)	N (%)	A (%)	SA (%)
12	Making enquiries help students to co-operate with each other.					
13	Making enquiry in physics lesson encourages students to participate effectively					
14	Making enquiry in physics practical work help students to perform better in class					
15	Making enquiry during practical work helps students to co-operate well with friends					
16	Making enquiries in physics practical work help students to understand physics better					
17	Making enquiries and co-operating with friends makes students active in class.					
18	I learn to work with students who are different from me.					
19	I enjoy the material more when I work with other students.					

SD – Strongly Disagree; D – Disagree; N – Neutral; A – Agree; SA – Strongly Agree. Figures in bracket are percentages.

Research Question 2

How will learner-centred instructional strategy be effective in encouraging participation in physics lessons in colleges of education?

No	Statement	SD (%)	D (%)	N (%)	A (%)	SA (%)
1	Interactive learning encourages students to participate well in physics lessons					
2	Learner-centred physics lessons help students to perform better					
3	Learning physics in groups help students to participate well in class					
4	Sharing ideas with colleagues during physics lessons encourage students to be active.					
5	Participating in physics lessons help students to share ideas and ask questions from colleagues					
6	I enjoy physics lessons when the tutor allows us to share ideas about the topic to find solutions for ourselves					
7	Sharing ideas in class during physics lessons encourage students to perform better					
8	Physics lessons become interesting when a lesson is centred among students and tutor acts as a facilitator.					
9	Working in groups encourages learners to share ideas in physics lessons					
10	Interacting classroom situation helps students to ask questions in physics lessons.					

SD – Strongly Disagree; D – Disagree; N – Neutral; A – Agree; SA - Strongly Agree. Figures in bracket are percentages.

Research Question 3

How effective do physics teachers use tlms in teaching physics in the colleges od education?

No	Statement	SD (%)	D (%)	N (%)	A (%)	SA (%)
1	Physics tutor uses TLMs to teach physics regularly.					
2	There are no TLMs in the school physics laboratory					
3	Physics tutor uses demonstration because materials are not available					
4	Tutors do not involve students in activities/practical work					
5	Our physics laboratory is well furnished with materials and equipment					
6	Tutors allow students to prepare TLMs on their own for physics lessons					
7	Physics tutors involve students in practical work using TLMs					
8	Using TLMs in physics lesson makes students to have a firsthand experience.					
9	Physics lessons are better understood when tutor involves students in practical lessons using TLMs					
10	Physics tutor uses TLMs to teach					
11	The use of TLMs in physics help students to understand lessons taught					
12	Tutors allow students to use materials for practical lessons					
13	TLMs are available in physics laboratory for activities/practical					
14	TLMs in physics class room makes students see real material interesting					

SD – Strongly Disagree; D – Disagree; N – Neutral; A – Agree; SA – Strongly Agree. Figures in bracket are percentages.

Research Question 4

Will the use of learner-centred instructional approach and TLMs help in the improvement of students' performance in physics in colleges of education in Ghana?

No	Statement	SD (%)	D (%)	N (%)	A (%)	SA (%)
1	Students enjoy learning physics when tutor centres the lesson among them					
2	Students enjoy physics lessons when tutor uses TLMs to teach					
3	Students participate well in class when tutor allows students to share ideas with the use of TLMs.					
4	Students perform better in physics class when tutors involve them in activities using TLMs					
5	Learning physics using TLMs makes it easy to understand physics concepts.					
6	Learning physics among colleagues encourage students to share ideas in class					
7	Learning physics among colleagues encourage students to increase their performance in class					
8	Tutor using learner-centred with TLMs to teach physics makes students active in class					
9	Physics practical/experiment helps students to make use of real materials to find solutions to problems.					
10	Learning physics in groups helps students to share ideas					
11	Learning physics in groups helps students to ask questions among ourselves					
12	Students perform better in physics class when tutors involve them in lessons.					

D (Strongly Disagree); D (Disagree); N (Neutral); A (Agree); and SA (Strongly Agree). Figures in bracket are in percentages.

APPENDIX B

Questionnaire for Tutors Teaching Physics Subjects in the Colleges of Education

Dear tutors, this questionnaire seeks to find out whether the use of leaner-centred instructional approach and TLMs to teach physics will improve students' performance better in your college. Please you are kindly requested to respond to the following questions. Every information given will be treated as confidential.

Section A

Name of College: ………………………………………………………………………

Sex ……… Male ( ) Female ( )

Highest qualification …………………………………………………………

Subject ……………………………………………..

Section B

Instruction: To respond to this questionnaire, please put a check mark (√) in the appropriate box to indicate your level of agreement or disagreement with the statements:

SD (**Strongly Disagree**); D (**Disagree**); N (**Neutral**); A (**Agree**); and SA (**Strongly Agree**)

Research Question 1

How does co-operative learning and enquiry encourage students learning performance in science?

No	Statement	SD (%)	D (%)	N (%)	A (%)	SA (%)
1	Involving students in lessons helps them to participate in lessons					
2	Involving students in lessons encourage them to be active.					
3	Involving students in enquiry helps them to find solutions to problem themselves.					
4	Involving students in practical lessons encourage them to co-operate with colleagues in class.					
5	Students' participate well in lessons delivery when allowed to share ideas					
6	Involving students in groups encourages them to co-operate in sharing ideas.					
7	Involving students in practical lessons helps them to make enquiry.					
8	Students are able to ask questions when they learn together					
9	Students are active in class when making enquiry.					

SD – Strongly Disagree; D – Disagree; N – Neutral; A – Agree; SA – Strongly Agree. Figures in brackets are percentages'

Research Question 2

How will learner-centred instructional strategy be effective in encouraging participation in physics lessons in colleges of education?

No	Statement	SD (%)	D (%)	N (%)	A (%)	SA(%)
1	Learner-centred approach is the best method to teach physics in colleges of education.					
2	Students are able to share ideas among themselves					
3	Students participate well among themselves					
4	Involving students much in physics lessons makes them active in class					
5	Students ask questions in physics when lesson is centred on them					
6	In learner-centred, students are allowed to share ideas together when tutors act as facilitator					
7	Students relate well with tutors when they are involve in physics lessons.					
8	Students are able to find solutions for themselves when lesson is centred on them.					
9	Performance of students increases when lesson is centred on them and tutor acts as facilitator					
10	Student's participation is very strong when learning is centred among them.					

SD – Strongly Disagree; D – Disagree; N – Neutral; A – Agree; SA – Strongly Agree. Figures in bracket are in percentage.

Research Question 3

How effective do physics teachers use tlms in teaching physics in the colleges of education?

No	Statement	SD (%)	D (%)	N (%)	A (%)	SA (%)
1	I use TLMs to teach physics always					
2	I use TLMs to teach if available					
3	I involve my students in practical lessons					
4	Using TLMs to teach physics is a waste of time.					
5	My school physics laboratory is furnished with TLMs and equipment					
6	My school laboratory does not have enough TLMs for teaching physics lessons					
7	Using TLMs to teach physics helps students to see real materials and participate well in lessons					
8	Using TLMs to teach allows students to have a firsthand experience with most materials in class/laboratory					
9	Using TLMs to teach my students makes them active in class.					
10	Students perform better in physics lessons when TLMs are used in teaching.					
11	Student's participation increases when they make use of TLMs in practical lessons					

SD – Strongly Disagree; D – Disagree; N – Neutral; A – Agree; SA – Strongly Agree. The figures in bracket are in percentage.

Research Question 4

Will the use of learner-centred instructional approach and TLMs help in the improvement of students' performance in physics in colleges of education in Ghana?

No	Statement	SD (%)	D (%)	N (%)	A (%)	SA (%)
1	Students grouped for discussion in physics lessons helps them to share ideas together					
2	Students participation in physics lessons helps them to find solutions for themselves during practical					
3	Students using appropriate TLMs for physics improves their participation in class					
4	Students using TLMs for learning physics lessons gives them easy understanding of difficult concepts					
5	Using appropriate TLMs to teach physics lessons increases students' interest in class					
6	Students using TLMs in physics lessons improve their performance in class					
7	Students are motivated to participate in physics lessons when lesson is centred on them with tutor acting as facilitator					
8	Students give better solutions to problems when allowed to share ideas in class					
9	Students' interest in physics increases when they are responsible for learning					
10	Students are motivated to participate well in class when they are responsible for learning					

SD – Strongly Disagree; D – Disagree; N – Neutral; A – Agree; SA – Strongly Agree. Figures in bracket are in percentage.

APPENDIX C

INTERVIEW GUIDE FOR BOTH STUDENTS AND TUTORS

This interview is being conducted as part of the research being conducted in connection with the teaching of physics in the colleges of education.

1. Were all the TLMs needed for the lessons presented in the laboratory?
2. Was the lesson centred on students and how?
3. Howdid the learners feel when working with TLMs?
4. What happened during the lesson?
5. Did physics tutors grouped students for the lesson and why?
6. What was the outcome of the experiment performed?
7. How did students co-operate with each other in the groups to find solutions to problem?

APPENDIX D

OBSERVATIONAL CHECKLIST USED FOR BOTH STUDENTS AND TUTORS

The researcher tick (√) the appropriate answer for these statements during his observations in each college studied. **Agree (A), Uncertain (U), Disagree (D)**

Name of College………………………………………………….

1. All TLMs needed for the lessons were presented in the laboratory.
   A ( ), U ( ), D ( )
2. Some of the TLMs presented were improvised.A ( ), U ( ), D ( )
3. The lesson was centred on students. A ( ), U ( ), D ( )
4. Lesson presentation focuses on the use of learner-centred teaching and TLMs in teaching physics. A ( ), U ( ), D ( )
5. Tutor allows students to use TLMs to perform experiment.
   A ( ), U ( ), D ( )
6. Tutor arranges students into groups for the lesson. A ( ), U ( ), D ( )
7. Students giving instructions to follow to perform experiments.
   A ( ), U ( ), D ( )
8. Students work with the TLMs to make enquiries. A ( ), U ( ), D ( )
9. Students co-operate with each other in the groups to find solutions to problem.

A ( ), U ( ), D ( )

10. Students discuss with each other to work with materials. A ( ), U ( ), D ( )

11. Students asked question from each other in groups to share ideas.

    A ( ), U ( ), D ( )

12. Students asked questions from tutor when having difficulties.

    A ( ), U ( ), D ( )

13. Tutor act as facilitator and co-learner during lesson. A ( ), U ( ), D ( )

14. Members in groups actively participating in lesson. A ( ), U ( ), D ( )

15. Students were happy doing their own learning. A ( ), U ( ), D ( )

16. Learners were happy working with real and appropriate TLMs.

    A ( ), U ( ), D ( )

17. Learners were encouraged during lesson. A ( ), U ( ), D ( )

18. Learners were interested in working with TLMs. A ( ), U ( ), D ( )

19. Learners' performance is increased during the lesson. A ( ), U ( ), D ( )

20. Learners were able to find solutions to problem and bring out new ideas.

A ( ), U ( ), D ( )