UNIVERSITY OF EDUCATION, WINNEBA

USING A MODEL (TLMs) TO ASSIST FEMALE JUNIOR HIGH SCHOOL PUPILS DEMONSTRATE RECTILINEAR PROPAGATION OF LIGHT IN BONGO DISTRICT

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

JANUARY 2022

DECLARATION

Students' Declaration

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

SIGNATURE:…….

DATE:…….…….

Supervisor's Declaration

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

SUPERVISOR'S NAME: PROF. K. D. TAALE

SIGNATURE:…….

DATE:…….…….

DEDICATION

I dedicate this work to my family.

ACKNOWLEDGEMENT

My special thanks go to the Almighty God for the abundant grace bestowed upon me throughout my entire academic endeavour and who in due time makes all things not only possible but also glorious.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Figure **Page**

ABSTRACT

The study examined how to demonstrate Rectilinear Propagation of Light using a Model (TLMs) with Collaborative teaching techniques to assist female Junior High School pupils improve their academic performance in Rectilinear Propagation of Light. The study used a descriptive survey that employed the quasi-experimental research and non-randomised Control and Experimental groups' pre-test – post-test design. The total population for the study was 227. The sample size was 74 students. The selection procedure was nonrandomised. Two Intact classrooms were used for the study. The Control group (Group A) and the Experimental group (Group B) consisted of an equal number of 37 students as this arrangement was the prevailing situation in the two intact classes at the time the study was conducted. Collaborative Approaches were used as treatment for the Group B; whiles the Traditional Method was used for the Group A. The instruments used in the study were Pre-tests, Post-tests and questionnaire. The reliability coefficients were found to be 0.736 and 0.751 for the pre-test and post-test respectively. Data were analysed using tables and bar charts. The results of the study revealed that the use of the Model resulted in significantly higher students' achievement in Rectilinear Propagation of Light than the Traditional Method.

CHAPTER ONE

INTRODUCTION

1.0 Overview

This chapter is the introduction aspect of the research, it deals with background to the study which gives highlights of the study , statement of the problem which aroused the interest of the researcher to delve into the study, purpose of the study which gives the reasons for the research, objectives of the research states what the researcher wants to achieve with the study, research questions which the researcher seeks answers to the study, and significance of the study which brings out the importance of the study, delimitations, and organisation of the study.

1.1 Background to the Study

There are fifty- seven Junior High Schools under the Bongo District located in the Upper East Region in Ghana. Out of these, seven are public and four are private in the central circuit, where the researcher teaches. Some of these Junior High schools run on double streams while others run on single streams. With the Ghana Education Service staff establishment, the Junior High Schools which run double streams are to have not more than six teachers, excluding the Head teacher and those of single streams of staff establishment of not more than three teachers excluding the Head teacher. It is sad and devastating to know that most of these Junior High Schools are without Science teachers. The school where the researcher is teaching currently was without a science teacher for almost a year after the then Science teacher was urgently transferred to the Bongo Senior High School, which was also in dire need of a Science teacher. The researcher was then reposted to her present school, which she found extremely difficult to leave her former school knowing that she was going to leave a void that probably may not be filled any time soon. The researcher was in a state of a

dilemma, torn between two deep red seas. She left her former school with a heavy heart and came to her present school. Thus, the Science teachers' deficit in the Bongo district.

Indigenes of Bongo District are predominantly into farming and fishing activities. The religious background of most of the inhabitants of Bongo are Christians however, there are a few Muslims and Traditional worshipers. The language spoken by the indigenes of Bongo is Gurene . Relatively, the parents of the pupils of Bongo Junior High Schools do not accord much importance to education as most pupils are always absent from school during market days, funerals and festivals. It is obvious pupils are used by their parents on market days to raise income for their respective families.

The parents do not mind whether their wards make it in school or not. To many of these parents education of the girl child is a waste of resources. Most of these parents believe that a girl is supposed be married after completing Junior High School education. Girls who are fortunate are allowed up to Senior High School to complete their educational ladder.

Science is an integral part of our daily lives because we use scientific methods in solving problems and understanding our environment. The importance of Science cannot be over emphasised:

Science is an essential element in daily life. Basic knowledge of science is mandatory for everyone as it makes life easier and opens our minds in many ways. Science deals with natural phenomenon based on facts and experiments and gives rise to new technology, which makes our lives easier. Therefore, science can be defined as a method of obtaining knowledge through observation and experimentation. According to the United Nations Educational, for Scientific and Cultural Organisation

(UNESCO), Science generates solutions for everyday life and helps us to answer the great mysteries of the universe. In other words, Science is one of the most important channels of knowledge, creating new knowledge, improving education and increasing the quality of lives (UNESCO, 2021).

Integrated science on the other hand involves the teaching and learning of various fields of science (physics, chemistry, biology, agriculture, etc) in a holistic manner such that none of the fields stands on its own or such that the various fields of science are interrelated.

In the teaching of integrated science, a subject of great importance, the researcher observed a problem on a physics topic "Light Energy" which is a topic in Physics. Female pupils most especially, were not able to demonstrate that light travels in a straight line, which is the concept of rectilinear propagation of light. This did not come as a surprise to the researcher because many pupils think and say, "Physics is difficult," (Ornek, Robinson & Haugan, 2008 as cited in Buah, Emmanuel, Akuffo & Asah Frank, 2017). The reason being that Physics as a discipline requires learners to employ a variety of methods of understanding and to translate from one to other words, tables of numbers, graphs, equations, diagrams, maps (Buah, et al. 2017) Physics requires the ability to use algebra and geometry and to go from the specific to the general and back. (Ornek et al. 2008 as cited in Buah, et al. 2017).

It is against this backdrop that the researcher took it upon herself to carry out this study by selecting one of the difficult topics in Physics: Rectilinear Propagation of Light:

1. Light Travels in Straight Lines.

2. Shadow Formation.

Light is a very vital factor of the abiotic environment, hence researcher deemed it very necessary to research into the problem.

Most Junior High Schools in the Bongo District have no Science teachers. This the researcher observed during an inter circuit Science and Mathematics quiz organised for learners recently in the District. Most of these Junior High Schools lack the fundamental Teaching Learning Resources (TLRs) needed for effective teaching and learning of Science not to talk of a well-stocked laboratory. Light, as a form of energy and an abiotic factor of the environment is a very vital tool as far as the ecosystem is concerned. The principle of rectilinear propagation of light which states that light travels in a straight line when comprehended by the pupils will help them demonstrate that light travels in a straight a line but when not comprehended, pupils will find it difficult to demonstrate the concept thus will go a long way to affect their academic performance in Integrated Science.

The Basic Education Certificate Examination results analysis, report 2020 for Bongo District in Integrated Science revealed that, out of a total number of 1093 girls who were presented for the examination only 16 girls had grades 1 to 3, representing 1.5% as against their boys' counterparts who out of a total of 920, 28 had grades 1 to 3, representing 3.04%, though not a good performance.

The Junior High School where the researcher currently started teaching for barely a year is an eye sore. The Bongo District Basic Education Certificate Examination 2020 results report for St. Anne's girls Junior High School where the researcher is, showed that out of a total of 45 candidates presented for the examination, only 3 girls had between grades 1 to 3, the best being grade 3 representing 6.6%; 8 girls had between grades 4 to 6; 11 girls had grades 1 to 6. The overall Basic Education Certificate Examination performance in Science of the whole school being 24.4%.

This persistent low performance in science by female pupils in Bongo district can be attributed to among other things:

• Lack of interest in the subject by female pupils. This lack of interest in the subject is clearly exhibited by the lackadaisical attitude pupils put up whenever science lessons are ongoing. For instance, some pupils deliberately find excuses to stay out of class when Science lessons are ongoing. Others behave hyperactively and not concentrating at all upon the efforts that the Science teachers make to get their attention in class, the worse of it all is that, some pupils stay away from school until the Science lessons are over before they make their way to class for other lessons whiles others do not come to school at all whenever there is an assessment to be taken by pupils such as a class test and /or examination.

• Misconceptions held by these pupils hold them back in their pursuit to studying science. The term misconception is an erroneous conception or mistaken notion. These misconceptions if not corrected early, can end up internally inconsistent picture of scientific perspective of the nature. Learners tend to build upon these erroneous ideas and move in a wrong direction; it can eventually drive students away from science (Joshi, 2013).

Misconceptions can also be described as ideas that provide an incorrect understanding of such ideas, objects or events that are constructed based on a person's experience (Martin et al. 2002) including such things as preconceived notions, non-scientific beliefs, naive theories, mixed conceptions or conceptual misunderstanding. The big issues are that once a misconception has been formed, it is extremely difficult to change (Eggen & Kauchak, 2004).

The notion held by many of these girls is that Science is a male dominated subject and that only males are suitable for such professions as medical doctors, Astronauts, Science researchers, etc.

• Insufficient Science Teaching and Learning Resources (TLRs). One of the most important resources that aid clear, easy and quick understanding by pupils in teaching and learning is using of appropriate TLRs. Science is demystified with little or no effort when the appropriate TLRs are used in the teaching and learning of Science. It is a pity that most of the Junior High Schools in the Bongo district do not have these TLRs in the schools, hence many Science teachers teach a lot of Science concepts abstractly which further deepens the woes of these pupils.

• The use of the old Traditional Methods of Teaching by many Science teachers to teach Science concepts. Many educational researchers have criticised the Traditional method of teaching, where pupils learn by rote; this method of teaching has over lived its usefulness thus, does not come with any advantage as far as teaching and learning is concerned. Many educational research works have recommended new, effective and efficient teaching and learning techniques available such as collaborative learning, cooperative learning, and critical thinking learning methods, digital learning methods and so on.

• Lack of adequate qualified Science teachers. Another obstacle that hinders pupils learning in Science is lack of qualified science teachers in the Junior High Schools in the Bongo district. The Science teacher's deficit is a big challenge facing the Junior High Schools in the Bongo district, where they is even a Science teacher, many a time that teacher may or may not have specialised in the Science area thus with the latter bringing in the problem of unqualified teachers to handle the subject. This problem of unqualified teachers handling Science makes it difficult to be handled as it were the

way it ought to be handled, thus, greatly affecting the performance of learners in the subject.

Collaborative learning is an educational approach to teaching and learning that involves groups of learners working together to solve a problem, complete a task or create a product. Group members base the underlying premise of collaborative learning upon consensus building through cooperation. (Laal, 2012 as cited in Al-kaabi, 2016).

• The concept of Collaborative Learning, the grouping and pairing of learners for the purpose of achieving a learning goal, has been widely researched and advocated; it refers to an instruction method in which learners at various performance levels work together in small groups toward a common goal, the learners are responsible for one another's learning as well as their own. Thus, the success of one learner helps other learners to be successful. (Gokhale, 1995 as cited in Laal and Ghodsi, 2011).

Many educational researchers including (Bean, 1996 & Johnson, 1985 as cited in Laal and Ghodsi, 2011) emphasised the endless benefits of Collaborative Learning; these include the following:

• Collaborative Learning is learner-centred leading to an emphasis on learning as well as teaching and to more learner ownership of responsibility for that learning. (Lowman, 1987 as cited in Laal & Ghodsi, 2011)

• Collaborative Learning reduces classroom anxiety created by new and unfamiliar situations faced by learners. (Kessler, Price & Wortman, 1985 as cited in Laal & Ghodsi, 2011).

• A significant benefit of Collaborative Learning is regarding to the groups operating long enough during a course. The learners in teams will get to know each other and extend their activities outside of class. Learners will contact each other to get help

with questions or problems they are having and they will often continue their communication in later terms, (Bean, 1996 as cited in Laal & Ghodsi, 2011).

• Students are actively involved in interacting with each other on a regular basis in an instructed mode; they are able to understand their differences and learning how to resolve social problems, which may arise. (Johnson & Johnson, 1985) as cited in Laal and Ghodsi, (2011).

• Higher-level thinking skills are developed (Webb, 1982 as cited in Laal & Ghodsi, 2011).

• Collaborative Learning provides many opportunities for alternate forms of learner assessment (Panitz & Panitz, 1996 as cited in Laal & Ghodsi, 2011).

• Collaborative Learning is a promising mode of human engagement that has become a twenty-first century trend. The need for thinking together and working together on critical issues has increased (Austin, 2000 & Welch, 1998 as cited in Laal & Ghodsi, 2011).

Hence, the researcher's zeal in using this teaching and learning approach to bring about improvement in the academic performance of female Junior High pupils in Bongo District.

1.2 Statement of the Problem

Over the past years stakeholders of Education in Bongo District has expressed concern over the poor performance of Junior High School pupils in the Basic Education Certificate Examination (BECE). Reports from the Chief Examiners of the West African Examination Council (WAEC) over the years (2019- 2020) have indicated that boys out performed girls in Basic Education Certificate Examination in all subjects and especially in Science. In addition, the Upper East Regional Director, Edward Azure, has expressed worry over the poor performance of public schools in

the Basic Education Certificate Examination (September 26, 2021) reports, Abdul-Rahman Musah. The Director made this known in an interview on DayBreak; Upper East Programme on A1 radio in Bolgatanga. Many factors account for this; among others could be the teacher factor.

Research has shown that when pupils are taught using experiential pedagogies which involves hands-on activities, enhance attitudes, (Gormally, Brick-man, Hallar, & Armstrong, 2009 as cited in Beem, 2020) improve exam scores, (Abdi, 2014 as cited in Beem) increase scientific process skills (Ergül, Simsekli, Calis, Ozdiek, Gocmencelebi & Şanli 2011 as cited in Beem, 2020) and potentially encourage more students to pursue STEM-related careers (van den Hurk, Meelissen, & van Langen, 2019 as cited in Beem, 2020). Therefore, the need to use an activity-oriented method – a Model that uses TLMs to teach the concept "Rectilinear Propagation of Light" to Junior High School girls in Bongo District.

1.3 Purpose of the Study

The purpose of the study is to use a Model (TLMs) in teaching to help improve girls' academic performance in Rectilinear Propagation of Light.

1.4 Research Objectives

This study seeks to:

1. determine the effectiveness of a Model (TLMs) with Collaborative techniques of teaching and learning on the academic performance of Junior High School girls in Integrated Science in Bongo.

2. compare the difference in performance between girls taught using the Traditional method and the Collaborative teaching techniques in Rectilinear Propagation of Light.

3. examine Junior High School girls' attitude towards Collaborative learning approach in Rectilinear Propagation of Light in Integrated Science.

1.5 Research Questions.

The following research questions guided the study.

1. What is the effect of using a Model (TLMs) with Collaborative learning approaches on Junior High School girls' performance in Rectilinear Propagation of light?

2. What is the difference in performance between girls taught Rectilinear Propagation of Light using Collaborative technique and their counterparts taught using the Traditional Method?

3. What is the attitude of Junior High School girls towards collaborative teaching and learning technique?

1.6 Null hypothesis

Ho 1: There is significant difference between the means of pre-test scores of girls of the Control Group (Group A) and girls of the Experimental Group (Group B) before using Traditional Method of teaching techniques and Collaborative teaching and learning techniques respectively.

Ho 2: There is no significant difference between the means of post-test scores of girls taught using a Model (TLMs) with Collaborative Teaching and Learning technique and those taught using the Traditional Method of teaching in Rectilinear Propagation of Light.

1.6 Significance of the Study

The study is conducted with the following prospects, which reflect the intended contributions of this study after successful completion:

• The product of this study will add to the already existing studies on rectilinear propagation of light and will form the basis for subsequent studies on the topic.

• It will also help pupils to understand perfectly how to demonstrate the concept of rectilinear propagation of light, which shows that light travels in a straight line using Models (concrete materials).

• This will transform the academic life of female pupils thereby empowering them to appreciate the fact that, education thus, Science is the key to be strong in a society.

1.7 Delimitations

Delimitations are the boundaries the researcher sets in terms of study duration, population size and type of participants. Delimitations are based on the researcher's decision of what to include and what to exclude.

The target group for the study is restricted to female pupils in three Junior High Schools owing to time constraint. The irregular attendance of pupils to school especially during the intervention stage brings problems in attaining the required outcome.

Finding Teaching and Learning Resources (TLRs) and sources of references relating to the research problem of Junior High pupils in Bongo District in the Upper East Region comes with a greater challenge.

Even though the girls encounter numerous problems in their Science learning, the study limits itself to solving the difficulty girls in Junior High pupils have in understanding the concept of rectilinear propagation of light.

1.8 Limitations of the study

The researcher wishes that the study covers the whole of the Bongo Junior High Schools but due to financial constraint and limited period, the study was limited to St Anne's R/C Girls Junior High School in Bongo District of the Upper East Region.

1.9 Organisation of the Study

This study is organised into five main chapters and they are as follows:

Chapter one which is introduction comprises background of the study, statement of the study, Purpose of the study, research questions, significance of the study, delimitations and organisation of the study. Chapter two covers review of related literature.

Chapter 3 involves methodology, which consists of research designs, population and sampling instruments and data collection procedure.

Chapter four forms part of the results/findings and discussions of the study.

The final chapter (five) embodies Summary, conclusion and recommendations.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

Rectilinear propagation of light is not a new phenomenon and as such, there is a variety of literature related to the current study. This literature was thus reviewed under the following headings:

- Causes of Poor Performance of Learners in Integrated Science.
- The Traditional Learning Method
- Improving the Poor Performance of Learners in Science.
- Motivation
- Theoretical framework
- Collaborative concept
- Collaborative Learning
- Practical learning
- The Concept of Rectilinear Propagation of Light.
- Experiments to Demonstrate Rectilinear Propagation of Light.
- The Applications of Rectilinear Propagation of Light.

2.1.1 Causes of Poor Performance of Learners in Integrated Science

The causes of poor performance of learners of Junior High Schools in Integrated Science discovered among other things in the Bongo district were:

2.2.1 Inadequate Teaching and Learning Resources

Inadequate Teaching and Learning Resources (TRLs) is one of the major causes of poor performance of most if not all in many subject areas with Science not being an exception. What the above simply mean is that the Teaching and Learning Resources found in most of the Basic Schools especially the Junior High Schools in the Bongo

district do not cater for the number of learners in demand; that is where learners turn to be fortunate to have few of these Teaching and Learning Resources. It is devastating to know that most unfortunate ones do not have at all. Thus, a majority of learners end up not getting these Learning Resources to work with during the activity time. As it is commonly said by educational psychologists that children learn most by doing- that is actively working with materials and participating in activity lessons as in Integrating Science. Therefore, when these Learning Resources are inadequate, this reduces largely the involvement of the learners in the lesson and hence causing poor performance of learners. According to (Bologun, 1982 as cited in Fred, 2017), learning resources play a paramount role in the teaching and learning of science subjects and inevitably the pupils' academic achievement in other subjects as well.

Despite the fact that there is the need for meaningful science teaching, many hurdles still prevent the effective teaching and learning of the science subjects. Poor capital investment in terms of provision of science learning resources contribute to pupils' low level of academic achievement, (Aguisibo, 1998 as cited in Fred, 2017). Fred asserted that, pupils and teachers believe that the performance can improve if the necessary resources are provided in their schools.

2.2.2 Textbook factor

Textbooks are one of the important curriculum materials in teaching and learning. These books contain what learners are supposed to learn in order to cover the topics given in the syllabus. There is an outline of keywords referred to as useful words in the textbook; in other words, unfamiliar words. These words also referred to as new words. At the beginning of every topic: the meaning of each of these useful words are well explained for easy comprehension of learners. Contained in the Science text books are logical and systematic explanations to scientific theories, principles and

concepts. Included in the test books are well drawn-out labelled diagrams for learner's easy learning and understanding. A concise topic summary is provided for each topic for learners' quick reflection and grasping of main ideas of topic. At the end of every topic, evaluation questions comprising of possible examinable multiple-choice questions, theory and practical questions given for learners' assessment. Majority of pupils in the district cannot afford to buy text books sold in the markets hence depend solely on teacher notes and government provided text books for their learning. This further deepens the woes of these learners in their quest to acquire knowledge. Imagine when a school does not have these Science textbooks for the learners to use during Science teaching and learning, what the learners are losing cannot be accounted for as far as teaching and learning is concerned, this is the situation of many basic schools in the Bongo district. It is so sad to know that many of the Junior High Schools in the district do not have a single test book for the learners to use and practice what they have been taught. In most cases, it is only one copy of the textbook in the school, which is for the teacher's use. The Ghana Education Service, which has the mandated to implement the education policies in the country at the pre-tertiary level, is responsible to allocate resources including textbooks. However, these textbooks are supplied to schools every decade, a period that is too long a time and makes it practically impossible for new textbooks to meet current ones in schools. By the time the new ones arrive, not even one of those given previously is found in majority of the schools. This may be because the learners are constantly using the books over a period of ten years, that is a decade, become wretched, worn out and definitely can no longer be used any more. According to (Ra & Jagannathan, 2018), textbooks are still crucial to the education process and provide attainments. Jagannathan stated that, a 2016 study by the Harvard Education Police Research

Centre found high achievement gains for students using high top quality textbooks. He further stated that the Policy Paper Why Text books Count by Cambridge Assessment was influential in bringing attention back to textbooks in England's poor performance in math compared to star performers like Finland and Singapore can be attributed to the fact that only 10% of teachers in England used textbooks.

There is no doubt that test books are preciously needed to improve academic achievement at the pre-tertiary level of education of which Junior High Schools are not exception. Lack of Integrated Science textbooks in many of the Junior High Schools in Bongo impedes the effective teaching and learning of Science there by causing poor academic performance in the subject.

Some teachers do not prioritize the use of test books provided by the Ghana Education Service (GES), they argue that the textbooks coming from GES do not contain enough content material so therefore resort to buying other textbooks for their personal use. They subsequently ignore using the GES provided textbooks (if there are any) of course no effective teacher likes to use a Teaching Resource that does not explicitly contain the content material needed for effective teaching and learning and hence their learners are not encouraged to use them either. The learners are left to their fate as far as the use of textbooks to enhance learning is concerned. Textbooks must cover all the necessary content material that both teachers and learners look out for. GES can equally supply schools with standard branded textbooks recommended by teachers.

The researcher in an attempt to help the situation constantly makes available teaching notes for every lesson for learners to take notes into their notebooks to enable them to learn, practice and retain what was taught them. This intervention did not only improve academic performance in class assessments but also in class tests and end of term examinations. Winkelmes, (2015) noted in her article that the problem of "the

inability to take information and make it one's own by processing it, restructuring it and then presenting it in a form so that it can be understood by others (or by oneself at a point later)" is one of the "basic skills" that is useful throughout life (p. 95).What this points out is that, teachers ensure learners particularly Junior High School level acquire basic skills in note taking and ensure they take notes that make meaning and present information for easy learning and understanding. Cross-checking learners notes snap shortly during note taking in lessons by teachers can promote the taking of meaningful notes by learners. Maryellen asserted that, students attended a two-week "talk and chalk" lecture. Using a random sampling selection process, 20% of the class was required to submit (two days later) a note restructuring assignment that was graded. "The hypothesis was that students would score higher on weeks in which they were randomly assigned to complete a note restructuring assignment, (as opposed to weeks in which they were not)" (p.97) According Maryellen, that hypothesis was confirmed and at an impressive level. "Students averaged 72% correct (SD =25) on questions from the week they completed a note-restructuring assignment, whereas they averaged 61% correct (SD =14) for other weeks." (p. 97)

Beyond helping students to dissect the most facts presented in the classroom lesson Gamechanger, (2019) note taking helps students to stay organised, alert and engaged. Moreover, note taking makes students better listeners. Gamechanger further stated that when students are taking notes, their bodies are actively involved in the lesson. Gamechanger added that, as students learn to take effective notes, they learn to distinguish the important facts from the superfluous information. They learn how to summarize and dissect lessons quickly and clearly. Gamechanger also pointed out the fact that speed is essential to effective note taking, this Gamechanger explained that, it helps students learn to think on their feet and quickly decipher information, helping to

improve students' processing speed. Gamechanger explains that since classroom lessons tend to move quickly, effective note taking requires greater concentration, previews and reviews of information. Learning to prepare for lessons ahead of time and review what one has learned from their notes reinforces positive study skills and builds academic competence. Furthermore, when students take effective notes, they learn to be organised. Note taking compels students to learn how to organise their thoughts as well as their physical work product. Gamechanger throws more light on this, stating that, this helps make learning linear and methodical. It also helps students to retain information long-term.

Gamechanger then concluded that, students should explore methods of note taking to figure out which style will allow them to determine what works best for them. Students, according to Gamechanger can take notes verbatim, writing everything down that the teacher says and re-organising the note later, taking notes in outline form, picking out and writing down the teacher's main points, requires quick processing skills and practice. Gamechanger in this piece recommends the employment of the Cornnell Method of note taking to students, which according to Gamechanger involves dividing a paper into sections, taking verbatim notes in class and then deciphering the important facts after class.

2.2.3 Reading factor

The inability on the part of learners to read is one of the greatest challenge faced by most pupils in the district. Many pupils in basic schools in Bongo are not able to read simple words not to talk of reading simple sentences. This makes it difficult for them to be able to spell words correctly. Reading is the act of looking at printed words and understanding or comprehending what they are saying, or the act of saying those words loud or interpreting those words (Dictionary definition). Reading according to

Wikipedia is the process of taking in the sense or meaning of letters, symbols, etc especially by sight or touch: For educators and researchers, reading is a multifaceted process involving areas such as word recognition, orthography (spelling), alphabetic, phonics, phonemic awareness, vocabulary, comprehension, fluency and motivation. Statistics according to Asare, (2021) the Executive Director of the African Education Watch, on World Literacy Day, a day which is marked and observed in the whole of Africa and the world over revealed that, eighty percent (80%) of children cannot read, this was aired on the national television, Ghana Television (GTV) on the 8th of September 2021.The above huge and unacceptable percentage tells us that a child's inability to read is a possible woe that can contribute to the poor academic performance of most pupils. Thus, it also points to the fact that being able to read is a very important component of the education process. Reading sets the pace for the learning process. A learner being able to read serves as a solid foundation on which any other learning activity can be built. Reading provides the gateway for not only enhancing academic success in Science learning but also grantees equal academic achievement for the other subjects as well. Reading (Gamechanger) is more than learning to decode and comprehend words. According to him, reading teaches essential life skills including:

1. Building a child's ability to focus and concentrate: Reading requires children to train both their minds and bodies to slow down and focus on the task. Focusing and concentrating on a book will also enhance a child's ability to remember things. This means that a learner who is able to read pays all the attention to what is being read, with the learner grasping what the reading material contains. Focusing and concentrating in class during teaching and learning enhances retentive memory in learners. The learner at this point is able to figure out whatever that is demanding and

is in a better position to retain what is learned and produce correctly when the need be. Ironically, in the classroom, most of the pupils if not all who are unable to read are usually not focusing and concentrating when Science lessons are ongoing. They are either talking or doing something different from what is being learned. A learner who does not focus and concentrate during teaching and learning cannot perform well in any examination.

2. Building communication skill: Reading is a basic form of communicating ideas and language. Giving children the opportunity to read will help them strengthen basic communications' skills. This buttresses the point that when learners are able to read and understand what a question(s) is requiring of them in the case of BECE, they are able to communicate effectively and appropriately by responding to question(s) posed them in writing. This promotes good performance. On the other hand, learners who cannot read obviously battles to communicate effectively in writing and therefore finds it very difficult to express themselves in presenting their ideas in examinations, and these learners end up performing poorly in their BECE of which Integrated Science forms part.

3. Building self-esteem: Reading gives children a chance to develop perspectives and formulate their own ideas. Becoming comfortable expressing ideas and opinions will give a child more confidence. What this simply mean is that when learners are able to read fluently and with understanding, it boosts their confidence level and thereby promoting their ability to be themselves in presenting their ideas. Pupils who are confident actively participate and make appropriate class contributions during Science lessons. These pupils are able to understand Science concepts easily with little or no difficulty. A learner who understands Science concepts and apply them correctly surely will perform well in BECE as compared to the one who has difficulty.

It is worth noting that in Science wrongly spelt words are not scored and because most of these learners are unable to read, they turn to spell a lot of Science terminologies wrongly, for instance, it has been consistently reported from 2014 to 2018 by the Chief Examiner that BECE candidates spell scientific terms and key words wrongly; examples such as 'Blood pod' instead of 'Black pod' and 'animea' instead of 'anaemia' 'rain guage' instead of 'rain gauge' and many more as weaknesses of candidates. The reports also emphasised that some candidates failed to show understanding of the questions they attempted and so gave answers, which were far-fetched. It is commonly said that, 'understanding of the question is part of the answer'. Reading leads to understanding and so if reading is not achieved, then understanding is clearly missing. It is not possible for Junior High School pupils to perform well in the BECE when they cannot read simple sentences. They have many difficulties understanding science concepts. It is even more shocking when the researcher found out that some pupils at the Junior High School level cannot even spell three and four lettered words correctly yet these pupils sit for the BECE. These candidates eventually do not perform well in their BECE and Integrated Science is not left off the hook.

2.2.4 Environment factor

Environment plays a very vital role for both the learners and the teachers. A conducive environment is a necessary component of the education process. Thus, it plays a critical role in the teaching and learning situation. Environment is the surroundings or conditions in which a person, animal or plant lives or operates. The learning environment here means that for instance, in most basic schools there are no comfortable sitting places for most pupils to sit and learn. In some cases, there is no classroom block where pupils get shelter; nevertheless, pupils sit in the sun during

lessons. In some basic schools where there are classrooms blocks, these are not well ventilated enough to motivate teaching and learning. He argued that the inability of teachers to get pupils cooperation, maintain their involvement in learning tasks and conduct the business of the classroom smoothly and effectively results into the poor performance of pupils. In his study, he argued that, little teaching and learning can take place in an environment that is not well managed. The environment many of the basic schools operate in is an eye sore. Many schools do not have enough desks for learners to sit comfortably in class. Others have their teaching and learning in deplorable buildings while some struggle with congested classrooms. A dual desk that is supposed to be occupied by two pupils, meanwhile in most schools four pupils sit on a dual desk. This uncomfortable situation hampers effective learning of these learners and does not encourage independence when it comes to testing. They are tempted to copy one another's answers during end of term/semester examinations. The condition does not groom candidates towards the one candidate one desk as it were during the writing of BECE. Thus, they find themselves wanting in the BECE hall when they are sitting alone and hence fail in the end.

A conducive learning environment according to Ziwira, (2015) is a platform devoid of both physical intimidation and emotional frustration that allows for a free exchange of ideas. He argues that the key proponents of the learning process are teachers and learners, as such their freedom of interaction, safety should be equally guaranteed within the physical and emotive environment they find themselves in. Ziwira added that the classroom should be neat, well ventilated and spacious to allow free movement. That the chairs and desks should be arranged neatly to give the teacher a clear view of the class, with learners facing the chalkboard, and that all learning and teaching materials should be at hand.

2.3.1 Science laboratory factor

Learning of Science cannot take place without a well-equipped Science laboratory but talking of Science laboratories in basic schools most especially Junior High Schools in Bongo is a nightmare. The researcher on several occasions will have to send her learners to the Bongo Senior High School to get to show them some simple Science Apparatus like Litmus Paper, Measuring Cylinder, Magnets, Iron fillings, Beaker to mention just a few which are supposed to be right there in the school for the learners to have access to every now and then, yet not. In fact, the distance between the school where the researcher teaches and the Bongo Senior High School take the pupils almost half an hour walk, meanwhile a Science lesson is supposed to take just 70 minutes for it to be over, so she ends up using the next lesson's period. This affects not only teaching and learning Science but other disciplines as well. The teaching and learning of Science cannot obviously be done effectively and efficiently without these above-mentioned fundamental simple Science Apparatus most importantly for beginners in Science. It is an imperative fact that beginners of Science learning must be introduced to basic Science Apparatuses. These basic Science Apparatus open up and acquaint the minds of these young and promising learners to learn Science with little or no difficulties. Even though many similar research works have been done which relates to this current study, equipping basic schools especially Junior High Schools in Bongo district with Science laboratories and a well-equipped one for that matter is yet to catch the attention of the stakeholders of education.

It is imperative for schools to have the latest and high quality laboratory supplies these days. Science is different from other subjects. In order to understand its concepts, one has to look beyond the books and conventional classroom teaching. Effective teaching and learning of Science involves seeing, handling and

manipulating real objects and materials. The knowledge that kids (learners) attain in classroom would be ineffectual unless they actually observe and understand the relationship between action and reaction.

Effective teaching and learning of Science involves a perpetual state of show and tell. Good schools combine classroom teaching with laboratory experiments to ensure that their students grasp each concept thoroughly. It is also believed that laboratory teaching and experiments that are being conducted there help encourage deep understanding in learners. Learners are able to retain the knowledge for longer when they see the experiments being performed in front of their eyes.

Science laboratories equipment allows students to interact directly with the data gathered. They get a first-hand learning experience by performing various experiments on their own. Students are made to use the models and understand different scientific theories and concepts. Furthermore, it is found that school science laboratories' equipment and supplies make teaching and learning easy both for the teachers, as well as for the students. Several scientific theories and concepts are difficult to explain directly from the books. Anatomy models, Physics science kits and Chemistry science kits for instance make it easy to understand the otherwise complex theories of Science.

By virtue of equipping themselves with the latest and the advanced materials and supplies, schools are able to contribute a lot in scientific advances yet to come. The advances and developments in the field of Medical Science and technology would not take place if schools do not prepare brilliant and dedicated scientists and researchers. Learners develop interest in scientific research in science laboratories. When they observe various things and carry out different experiments, their reasoning skills are honed and they start thinking deeply on those theories and concepts. Thus, schools

must have the latest science laboratories, supplies and equipment to make Science interesting and effective for learners and to encourage them to make significant contributions in the field of Physics, Biology, Chemistry and other streams of Science later in life (Gayle, 2015).

According to Kristen, (2019) a real but not always obvious gain of students' complete laboratories is that they get the opportunity to learn about aspects that are difficult to grasp from just reading about them. These aspects include but not limited to sources of error, the interconnectedness of concepts and the physical limitations of the laboratory experiment. When students have to create a famous experiment themselves, it brings to life the realities that those highly regarded Scientists dealt with. It also shows students why it can be very difficult to prove an idea using a physical experiment and why it often takes so many trials and years of hard work to prove an idea and turn it into a theory. Laboratories also demonstrate to students how interconnected they learn; like when they try to prove that there is no horizontal acceleration when learning about motion in Physics, they have to disregard the effects of friction and air resistance. This also gives them the opportunity to brainstorm their own ideas of how to minimise these effects, which gives them a chance to exercise logic and abstract thinking. Alternatively, when they perform a chemistry titration and forget to put an indicator, phenolphthalein, and the test tube never changes colour. Laboratories can give students the chance to discover a scientific principle on their own. Kristen stated an example that, in his AP Physics classes, students were asked to complete some experiments before the unit starts. This gives them the chance to think through what they see happening the same way countless scientists have before them, sometimes even deriving the equations that would be used in the unit from one's own experimental data. Giving students that opportunity can do wonders for their

confidence and ensure that they understand why the abstract ideas presented are true and how the questions are developed.

It is obvious from the above that scientific researchers like Gayle, Kristen and many more Science researchers have attested to the fact that school laboratories are important components to Science teaching and learning. Thus, setting up Science laboratories in basic schools in the Bongo district will not only enhance the teaching and learning of Science there by improving academic achievement which is the hall mark of this study, but will also go a long way to save both teachers and learners the stress and time of going to Senior High Schools to parasite on their limited Science resources. The researcher asserts that no meaningful science education programme can exist without laboratory facilities. Laboratory facilities are indispensable to good science teaching and learning.

2.3.2 Science Resource Centres factor

The absence of a Science Resource Centre (SRCs) in Bongo district poses a setback for both teachers and pupils in the district in their quest to teaching and learning Science and Science related subjects. The importance of a Science Resource Centre is overwhelming these include among others: Value-adding to the formal learning needs of the Science Curriculum. This provides the opportunity for a range of authentic Science learning. It encourages the ethic of excellence but also teaches the 21st century skills such as teamwork; critical thinking and problem solving that are so difficult to teach in the formal education setting. It is learner-centred and teacher facilitated. (Oliver, 2014).

These Science Resource Centres (SRCs) when well managed and utilised serve as Science museums where teachers, learners and other Science loving people and scientists go to carry out scientific experiments in which the results are used for the

benefit of society of which pupils are not left out. The last time the researcher saw the construction and the establishment of a Science Resource Centre was almost two decades ago in the West Gonja district Damongo, now the capital of Savannah Region. They were constructed not in every district but in some selected districts across the nation. Many educational and Science research works failed to draw the attention of education policy makers as well as education stakeholders to the usefulness of SRCs as far as learning of Science is concerned and this also causes poor academic performance of learners. SRCs should be built, well stocked and well established with qualified laboratory technicians to provide teachers the opportunity to try out scientific experiments beforehand. An experiment is well carried out by a teacher when she or he tries it out beforehand; this is because preparations are far made to curb any shortcomings including precautions to be taken during the experiment. SRCs are always opened even when schools are not in session this make them a 24-hour service, which makes it better for one to always have access anytime. Therefore, it is substantially clear that SRCs are empirical resources that can make the teaching and learning of Science demystified for learners' easy understanding of Science theories and concepts as well as experiments.

2.3.3 Learners background factor

The background of learners play a critical role in the learning process. In the Chief Examiner's Report, (2004) in Science, it was stated that poor performance of pupils in Science in BECE is mostly caused by very poor background of most pupils, hence the pace of teaching and learning is often much slower than anticipated.

2.3.4 Teacher characteristics factor

Rosenshine, (1993) have written a useful review of this study and have identified five teacher characteristics constantly associated with gains in pupils academic

achievement. The first two characteristics are enthusiasm and business like orientation. The third characteristic is teacher clarity or lack of it in various ways. For example, the amount of time a teacher uses to answer pupils' questions requesting clarification of what the teacher has said, the frequency with which pupils respond to teachers' questions without the teacher having to interpose additional information or question and the avoidance of vague words etc.

The fourth characteristic by Rosenshine and Furt is the variety in teaching. This characteristic can be estimated by counting the number of instructional materials, test and teaching devices used by the teacher.

Another indication is the extent to which the teacher provides opportunities for pupils to learn the curriculum content covered in the achievement test. Research studies carried out in many parts of the world have shown that the majority of teachers questions call for specific fact answers or lower cognitive thought processes in forming answers which have an important role and the critical thinking questions which requires application of the concepts learned. Both types of questions have their roles to play in teaching-learning processes, a heavy reliance on lower order questioning encourages rote learning and does little to the development of higher thinking order processes.

In another study of Flanders, (1990) and his associates observed two contrasting styles of teaching: Direct teaching and indirect teaching. Direct teaching is characterised by teachers' reliance on pure lecture, criticism justification of authority and giving of directives while indirect teaching is characterised by questions, accepting pupils' ideas and giving praises and encouragements when required.

Some substantial studies have shown that pupils of indirect teachers learn more and definitely have better attitudes towards learning than pupils of direct teachers' have.

Pupils under indirect approaches often bring their potentials to reality by making impact in their various fields of endeavours.

2.4.1 Leaners attitudes towards science

Attitudes of most learners towards the teaching and learning of Science in the Junior High Schools is appalling. Attitude according to Oxford dictionary is a settled way of thinking or feeling about something. According to Cherry, (2021) Psychologists define attitude as a learned tendency to evaluate things in a certain way. This include evaluations of people, issues, objects or events. Such evaluations are often positive or negative, but can also be uncertain at times. Many learners do not take the learning of Science seriously and attached no interest in the subject and this contributes to the poor performance in the subject upon their completion of the BECE. This, the researcher observed whenever it is time for Science lessons. Many pupils either leave the classroom before the Science teacher enters or start leaving when they see the Science teacher. Those who decide to sit for the lesson do not concentrate or pay attention to what the teacher is doing; they either engage their mates in talking in class when the lesson is ongoing or ask for frequent permissions to leave the class unnecessarily. Others deliberately absent themselves from school any day there is Science on their class timetable and even worse, when the teacher announces that there will be a class test the next day, some pupils will stay away from school just to dodge a Science class test. When the researcher contacted some of her colleagues Science teachers in different schools in the district on the attitude of their learners towards Science, the story was not different. The result is that the pupils who put up these behaviours end up performing poorly in their end of term and/or semester examinations and eventually performs even worse in their Basic Education Certificate Examination (BECE).

Researchers suggest that there are several different components that make up attitudes:

i. Cognitive component: One's thoughts and beliefs about the subject.

ii. Affective component: How the object, person, issue or event makes one feel.

iii. Behavioural Component: How attitude influences one's behaviour.

Kendra further stated that attitudes could be explicit and implicit. Explicit attitudes for him are those that we are consciously aware of and that clearly influence our behaviours and beliefs. Implicit attitudes are unconscious but still have an effect on our beliefs and behaviours. According Kendra, there are a number of factors that can influence how and why attitudes form. Here is a close look at how attitudes form.

Experience: Attitudes form directly because of experience. They may emerge due to direct personal experience, or they may result from observation. This means that the poor attitude of learners towards the learning of Science can be due to something they have experienced either personally or through what they have seen. With this, teachers as facilitators of knowledge acquisition should take it upon themselves to always have talks with learners in relation to their experiences in learning on subject basis where they share these experiences. Creating an opportunity for learners to air their personal experiences will go a long way to encourage learners to change their poor attitude towards Science and rather embrace learning the subject to resolve this challenge. When learners develop a positive learning attitude towards Science, many great scientific achievements can be made in the science society.

Social Factors: Social roles and social norms can have a strong influence on attitudes. Social roles relate to how people are expected to behave in a particular role or contest. Social norms involve society's rules for what behaviours are appropriate. What it means is that, in our societies, there are certain roles that are normally assigned based

on one's gender that is being a male or a female. The researcher earlier submitted in this study that most parents and/or guardians in the Bongo district do not prioritise education when it comes to the girl child. They feel that educating their girl child is a waste of their resources. For them, education should be for males. Some even have it that, certain careers such as medical doctor, engineer and other Science related careers are meant for males. They hold a perception that the role of the girl child is in the kitchen, whiles others say that the highest form of education to offer to a girl is the Junior High School level and then prepare her for marriage. Pupils most especially girls tend to absent from school when funerals are being performed in their families. The pupils say, "The dead will not be happy with them when they do not stay home through to the final funeral rites." These and many more are some of the social factors that militate against the performance not in only Integrated Science, but the other subjects.

Learning: Attitudes can be learned in a variety of ways. Conditioning; Operant conditioning can also be used to influence how attitudes develop.

Observation: People also learn attitudes by observing people around them. When someone you admire greatly espouses a particular attitude, you are more likely to develop the same beliefs. For example, children spend a great deal of time observing the attitudes of their parents and usually begin to demonstrate similar outlooks. To curb this problem, the researcher collaborated with the Guidance and Counselling teacher in her school and organised a series of guidance talks for pupils on the importance of Science and technology in our societies, the nation and the world at large. This intervention brought about a tremendous positive change in attitude of leaners' during subsequent Science lessons. There were no absentees during Science lessons. They paid attention and participated actively in class during Science lessons.

Learners class participation improved and consequently improvement in their class exercises, class tests and end of term examinations.

The investigation of students' attitudes (Osborne, Simon, & Collins, 2003) towards studying science has been a substantive feature of the work of the Science education research for the past 30-40 years. Its current importance is emphasised by the now mounting evidence of a decline in the interest of young people in pursuing scientific careers (Department for Education, London, 1994 as cited in Osborne et al, 2003 and Smithers and Robinson, 1988). Combined with research indicating widespread scientific ignorance in the general populace (Durant and Bauer, 1997, Durant, Evans and Thomas, 1989 and Miller, Pardo and Niwa, 1997 as cited in Osborne et al), and an increasing recognition of the importance and economic utility of scientific knowledge and its cultural significance, the falling numbers choosing to pursue the study of science has become a matter of considerable societal concern and debate. Osborne et al argues that, the promotion of favourable attitudes towards Science, Scientists and learning Science, which has always been a component of science education, is increasingly a matter of concern. They maintained that, the concept of an attitude towards Science is somewhat nebulous, often poorly articulated and not well understood. They also asserted that, concerns about attitudes to Science are not new, citing Ormerod and Duckworth, (1975) who began their review nearly 30 years ago on the topic. They concluded that a modern society Science and Technology is a prominent and important aspect of the society can ill afford to produce three times as many as arts and humanities specialists as it does Science specialists and that irrespective of the economic effects, the decline of interest in Science remains a serious matter of concern for any society attempting to raise its standards to scientific literacy.

Despite the fact that science informs our thoughts and behaviours, many people do not seem to place a high value on science. Studies show that the general public (non Science majors) do not generally have positive feelings towards science and scientists (Rogers & Ford, 1997 as cited in Fred, 2017). According to Ungar, (2010) as cited in Fred, (2017) a positive attitude towards science may improve pupils' academic performance not only in science classes, but also in other subjects as well. It is therefore in the interest of the society and the responsibility of educators, to improve pupils' attitude towards science and to prepare pupils to live in a technological society. Citizens who are able to understand and help shape the complex influences of science and technology on our world will determine the future of our society. If the pupils change their attitude towards science subjects, the performance in their results will definitely improve since they will dedicate more time towards learning the science subjects (Fred, 2017).The above clearly points to the fact that many studies have reviewed the topic of this current study.

2.4.2 Teacher competence

Incompetence on the part of those teaching the various disciplines in Science contributes a lot to the poor performance of learners in Science in particular and other disciplines in general. A teacher cannot run away from being incompetent when he or she is made against all odds to teach or handle a subject outside his or her specilised area. For example, if a teacher specialises in Social Studies and is made to teach Integrated Science, though he or she is competent when it comes to his or her area of specialisation, definitely becomes incompetent when it comes to teaching Science. According to (Fred, 2017), the impact of teachers on performance in any subject is very high and that teachers are the facilitators who are to impact the theories and concepts into pupils. Fred asserted that, the teacher is the work force saddled with the

responsibility of impacting the concepts considered fundamental to technology through the teaching of these basic concepts. Fred argued in his study that, in a study conducted by Adeniyi, (1993), noted that, a country's work force development depends on the quality well-qualified teachers.

It is worth noting that every country relies on her teachers to implement the country's educational goals to the learners in order that they (learners) come to take up the technological, economic and social needs of the nation. An incompetent teacher will only frustrate these aims and goals by compounding the already challenges faced by learners. At the end, the education system produces graduates who cannot take up the socio-economic needs of the nation. According to (Boateng, as cited in Mohammed,2016) the teacher is the pivot of the education system as he or she makes or breaks the education programmes, delivers the objectives of education reforms and is engine of everything that is planned and implemented in school. These objectives of the education sector according to Fred, cannot be attained when incompetent teachers teach the pupils, such teachers would not be able to properly disseminate the concepts to the pupils. Thus, a well trained professional competent teacher must possess such qualities as (Ajayi, 2009 as cited in Fred, 2017) mastery of subject matter, sense of organisation, ability to clarify ideas, ability to motivate students, good imagination, ability to involve the learners in meaningful activities throughout the period of teaching, management of the details of learning and frequent monitoring of learners' progress through tests and examinations. In view of this, the researcher is of opinion that teachers be strictly made to teach subjects of their specialisation. She is also of the view that, making teachers teach subjects of their specialisation is not enough but that organisation of regular teacher in-service training organisation of workshops,

conferences and symposia are paramount to keep the 21st century teacher always abreast with the new trends of the education processes in achieving desired results.

2.4.3 The Traditional Learning Method

The traditional method of teaching and learning sees teachers as passing over their knowledge to their pupils (Bennett, 2003 B; Trowbridge, Bybee, & Powell, 2000 as cited in Osei, 2014). This view is strongly linked to expository teaching; teachers standing at the front telling their pupils about scientific ideas. The traditional method implies that the role played by pupils in the learning process is largely passive, and that a pupil's mind is a blank slate onto which knowledge can be written. (Ajaja, 2013) as cited in Osei, (2014) states the following advantages of the traditional teaching method:

• it is easy to create interest in a topic or subject by the teacher.

Students easily acquire knowledge, new information, and explanation of events or things.

• it helps students to clarify and gain better understanding of a subject, topic, subject matter or event.

• students and teachers cover more content materials within a short period.

The major limitation of this method is that there is relatively little student activity and involvement (Bennett, 2003; Trowbridge et al., 2000 as cited in Osei. Thus, the students are said to be passive.

Though the Traditional Teaching Method comes with some advantages, it has usually criticised by many educational people for the merit of learners. Becky; Burkham; David; Lee; Valerie and Smerdon (1999) as cited in (Jaebi, 2019) identified the following disadvantages of the Traditional Teaching Method:

• Lacks Student Focused Learning.

A drawback of traditional training is that it inherently places the most value on standards, curriculum and passing tests as opposed to student-focused learning. Student-focused learning places value on the student and builds the curriculum around the questions young people need to answer in order to understand the material. Constructivist learning builds on the knowledge students already have allowing them to form concrete associations to new information, which improves retention. Traditional learning is based on repetition and memorization of facts that students care less about and retain at lower rates after testing.

• Lacks Emphasis on Critical Thinking.

Traditional classroom training does not encourage critical thinking skills, the ability to actively apply information gained through experience and reasoning. Instead, traditional training emphasises the role of teachers as knowledge dispensers and students as repositories. This style of learning does not allow students' deeper levels of understanding required for complex concepts and lifelong learning.

• Lacks Process Oriented Learning.

Traditional training emphasises passing tests, whether or not students understand testing material. The learning process is thus devalued, and students are not encouraged to understand the methods, techniques and skills required to find answers. Constructivist learning holds the process as important as the results because it stimulates skills long after schooling.

• Lacks Emphasis on Larger Concepts or Structures.

Rather than focusing on larger concepts and considering student context in the learning as constructivist training does, traditional training focuses on basic skills and gradually builds to a whole. While this simplifies learning, it provides little context, which can disconnect learners.

• Lacks Interactivity.

Traditional training emphasises individual student work and projects and is poor preparation for a student's future endeavours, which are likely to include working on teams and collaborating with colleagues. Under this training model, students receive few opportunities to practice group dynamics and teamwork

2.4.4 Improving the Poor Performance of Pupils in Science

The Chief Examiner's report, BECE (2004) on Science stated that some reasons accounted for the poor performance of pupils in Science. If teachers are to be successful in effective teaching and learning or attracting the interest of the pupils, then the pupils' attention should be captured and focused on the proper use of reinforcement to increase pupils' responses. There are however, a number of reinforcements according to Rosenshine, which are less frequently used, yet can provide pupils with maximum rewards. An important type of reinforcement which is less than ten percent (10%) used of the time, is when teachers respond to the ideas pupils express by accepting them, building on them and asking questions based on them. If all the above-mentioned suggestions are embraced, it will go a long way to arouse the interest of learners and sustain this interest in the subject, which will not only boost the performance level of learners in the subject alone, but other disciplines as well.

Miller, (1957) suggested that for learning to be effective through the use of the principle and reward, what is presented for the individual to learn must not be very easy or too difficult, that is, the items must be within the experience of the learner and his or her ability. The items in view must be able to arouse the curiosity of the learners, that is, helping them to learn more-this implies that teachers as facilitators in the classroom should follow the sequence of known to unknown; that is, learning

should be begin with what learners already know, once learners have an idea or know about something that is to be learned, their curiosity is aroused thus their interest is sustained throughout the lesson. It has been indicated that classes where reinforcement techniques are supplied, pupils have more positive attitudes than classes where pupils' ideas are not incorporated in the development of lessons. Such verbal reinforcement can be a powerful motive for increasing pupils desire to participate in lessons.

Flanders, (1990) in her studies indicated that classes where reinforcement techniques are supplied, pupils have more positive attitudes than classes where pupils' ideas are not incorporated in the development of lessons. Such verbal reinforcement can be a powerful motive for increasing pupils desire to participate in lessons

2.5.1 Motivation

A skilled teacher recognises that without motivation for students to involve themselves in learning, even the most effectively designed learning process will be unsuccessful. In other words, learners who are motivated to study will have greater success than those who are not (Al-kaabi, 2016). Moreover, Al-kaabi, noted in her study as she cited (Hodges, 2004), that students who study well will be more motivated to do so in the future. Thus, motivation is the main factor in any learning environment. Motivation can also be identified as the main source of student success in the learning process. Motivational beliefs consist of various different constructs that have been generated by different theoretical models, such as goal theory, intrinsic motivation theory, and attribution theory (Yukselturk and Bulut 2007 as cited in Al-kaabi, 2016).

Motivation is an ability to motivate an interest in an identified population of learners (Leacock and Nesbit 2007, p. 45 as cited in Al-kaabi).

(Greener, 2008 as cited in Al-kaabi), classified motivations into four types as follows:

1. Competence motivation, which is concerned with successful learning practices.

2. Extrinsic motivation, which is related to competence or high marks.

Extrinsic motivation is involved when an action is completed for achieving some independent outcome. Extrinsic motivation differs from intrinsic motivation, which relates to participating in an activity just for the enjoyment of the activity itself, instead of looking at its instrumental value.

3. Intrinsic motivation is concerned with knowledge and understanding of subjects.

Intrinsic motivation is a vital instrument for open-ended cognitive expansion, as it is "the driver of spontaneous exploration and curiosity" (Oudeyer and Kaplan 2008, p. 1 as cited in Al-kaabi, 2016).

4. Achievement motivation is concerned with improved self-esteem through achievements. Achievement motivation theorists "try to express choices of people in achieving tasks, persistence on those tasks, force in carrying them out, and performing on them" (Wigfield and Eccles 2000, p. 68 as cited in Al-kaabi) Motivation is necessary for both teachers and learners and it is necessary to determine how to motivate students in any learning environment (Ocak and Akçayır, 2013 as cited in Al-kaabi,). Key factors that allow conceptual change to happen include clear aims for both teachers and students, collaboration with peers, teaching with dialogue that promotes activities to encourage deeper understanding, freedom for the student to engage meaningfully in the task, and motivation that is intrinsic to the student (Marcus et al. 2004 as cited in Al-kaabi).

2.5.1 Theoretical Framework

Collaborative learning depends on constructivist theory, which posits that knowledge is built and translated through students. Constructivism in science education is based

on a philosophy that all learning is constructed and that new knowledge is built upon the prior experiences of the learner (Naylor, 1999; Kruckeberg, 2006 as cited in Osei, 2014). The foundation of constructivism according to Osei,(2014) is attributed to the work of Dewey, Piaget and Vygotsky, who argue that how students respond to new learning situations is influenced by their prior knowledge (Hyslop-Margison & Strobel, 2011 as cited in Osei). This philosophy has influenced a change in science curriculum and instruction to take into account students "experiences". Fox, (2001) as cited in Osei, asserts that the foundation of constructivism is based on the idea that learning is not passively absorbed. Knowledge is both invented and personal to the learner in an active process. The key for learning is fundamentally linked to the active participation of the learner. New knowledge can only be constructed by linking meaning to the learners' previous, existing knowledge (Naylor, 1999 as cited in Osei). Constructivism also gives teachers another angle to look at how students learn and to focus on processes and provides suitable ways of documenting change and transformation. It also serves as a reminder to teachers to look for different ways of engaging individual students, develop rich environment for exploration, prepare coherent problem sets and challenges that focus the model building effort, elicit and communicate students perceptions and interpretations (Abdal-Haqq, 1998 as cited in Osei). Osei also, as cited in Ultanir, (2012) who argues that some aspects of the pedagogy of Dewey, Piaget and Montessori share some commonality in regards to the knowledge learning process of a child. Each of them agrees that the acquisition of knowledge and learning is about constructing meaning as opposed to passive reception. An individual's process of developing new knowledge is affected by previously acquired knowledge. Constructivists again, maintain that individuals construct or create their own new understandings or knowledge through the

interaction of what they already know and believe and the ideas, events, and the activities with which they come into contact (Richardson, 1997 as cited in Osei). The settings of a constructivist learning environment is characterized by, engagement, inquiry, problem solving, and collaboration with others. According to Osei, as he cited in Ismat, (1998) in his study, the teacher in such an environment serves as a guide, facilitator, and co-explorer who encourage learners to question, challenge, and formulate their own ideas, opinions, and conclusions deemphasizing "correct" answers and single interpretations. Several publications cite the importance of teachers' modelling constructivist approaches that engage students in interdisciplinary exploration, collaborative activity, and field-based opportunities for experiential learning, reflection, and self-examination (Kaufman, 1996; Kroll & LaBosky, 1996 as cited in Osei), if future teachers are to be able to employ these strategies in schools. Osei in his study further asserted that, Piaget, (1970) suggests that learning occurs through the construction of meaning rather than through passive reception. Osei, according to Piaget, when a student is confronted with new information, he performs the functions of assimilation and adaptation. He compares this information with knowledge that already exists in his mind. If the old information does not conform to the new, he reorganises his mind with respect to the new information. Thus, a learner's cognitive development can be said to be a continuous effort. The learning process must be realised as something learned through activation of the existing cognitive structures or by building new cognitive structures that adapt to new input. Instead of passively acquiring knowledge, learning takes place between all the students and teachers in the process. Furthermore, collaborative learning is described from different angles: social presence, motivational forces, cognitive presence and community of inquiry (Lowyck and Poysa, 2001 as cited in Al-kaabi, 2016).

2.5.2 Collaborative Concept

The operative application of collaborative blended learning is primarily about creating chances for learning opportunities and instruments to achieve the optimal learning environment (Marsh, 2012 as cited in Al-kaabi,). According to Al-kaabi as cited in Dooly, 2008, p. 22), there are several advantages of collaborative learning: for example, collaborative learning allows the fostering of a spirit of co-operation among the students, enhances the potential of the students, and increases their ability to debate. In addition, the mission of the collaborative learning design is to provide opportunities for students to communicate effectively to encourage mutual support in order to master the purpose of the lesson. Collaborative learning shifts some of the duty to teach onto students, since the intention is that they become researchers and self-directed learners, as well as taking responsibility for their own learning. Ideally, the teacher should understand the principles of collaborative learning and the preferred learning styles of their students, and thus improve the co-operative education programme (Al-kaabi, 2016).

In addition, Al-kabi noted in her study as cited in Stahl, Koschmann and Suthers (2006), collaborative learning has many characteristics such as co-operative behaviour, the acquisition of knowledge, delegating decisions, etc. to develop student trust and retention, which add value to both student and classroom. Hence, the teacher can determine how to introduce collaborative learning and where to begin. Bower and Richards, (2006) as cited in Al-kaabi, stated that, there were some skills benefits, which have had a large impact on collaborative learning pressure, like the evolution of overall connection influences, sympathy, and cooperation. This pressure depends on the teacher not as the major supplier of information or control, but as a facilitator. Collaborative learning requires working together towards a joint aim. This type of

learning is also known as collective learning, cooperative learning, peer learning, learning communities, team learning, collaborative learning, or peer teaching. However, collaboration is more than co-operation. Collaboration means the whole process of learning, which consists of students teaching the teacher, students teaching one another and the teacher teaching the students. More significantly, Al-kaabi asserted as she once again as cited in (Dooly, 2008), it also means that students have a responsibility towards another learner in addition to themselves, such that achieving collaborative learning method goals involves students assisting each other to learn and understand. Furthermore, in the collaborative classroom, it is primarily through the interactions and relationships between learners that knowledge is created. Thus, in order to be successful, this learning process needs to pay attention to developing a sense of community among the learners. However, interaction must be more systematic and structured (Garrison & Cleveland Innes, 2005 as cited in Al-kaabi).

As the researcher stated earlier in the first chapter of this study, Collaborative learning and teaching approach is a promising learning approach, which was blended with other teaching techniques; practical hands-on activities teaching techniques by the researcher to improve the academic performance of female Junior High School students in topic Rectilinear Propagation of Light.

2.5.3 Collaborative Learning

The idea of collaborative learning dates back to between 1950 and 1960 that was used by doctors to deal and communicate with medical students, where it was noted that the students who were working in groups had medical assessment and results better than those who were working alone which reflected the great success of this idea. The best way to understand the method of collaborative learning is with the

definition of these concepts as viewed by Swan, Shen and Hiltz, (2006, p. 46 as cited in Al-kaabi):

- Collaborative learning is a teaching strategy that includes a small group of learners working together in order to develop the educational experience to the maximum extent possible.

- Collaborative learning is defined as the work of individuals as members of groups, and each student of the group is linked to mental, emotional, and behavioural functions to achieve the objectives of the community and systems whose clear objectives help learners in the decision-making process and increase the sense of community.

- Collaborative learning stands on the idea that learning is a naturally social act in which learners talk amongst them, and among the talk the learning occurs.

- Collaborative learning is "a case, where such a case includes the following main aspects: first, two or more students learn or try to learn something together; second, 'two or more' may be explained as a pair, a small group (3-5 students) or a class (20-30 students); third, 'learn something' may be explained as follow a course or perform learning activities such as problem solving. Finally, 'together' may be explained as many forms of interaction which may be face-to-face or computer mediated".

Arguably, collaborative learning aims to support the most effective teaching possible for the greatest number of students. There are five basic elements in a collaborative learning environment (Laal and Laal 2012, p. 491-495 as cited in Al-kaabi), pointed out:

- Collaborative learning obviously perceives positive correlation; members in the work group are committed to depend on one another to gain the goal. Moreover, if any member fails to perform their task or responsibility, all members in the group

suffer the consequences. This means the teacher must plant in the hearts of the learners the importance of collaborative teaching to build a collaborative learning environment.

- Great communication and interaction: developing effective communication skills to interact with others contributes to an exchange of information and ideas through various channels to achieve the goals. Furthermore, successful communication depends on several factors such as the interaction between the teacher and the learner and the means of delivery in addition to the effects of the surrounding environment.

- Individual accountability and personal responsibility; each student in the team is responsible for performing their task and reaching a high level of mastery.

- Social skills: understanding behaviour of each student is imperative to succeed.

There are a set of social skills learners should have such as confidence, calmness, decision-making, empathy, smiles, and communication.

- Group self-evaluating: in order to improve the teaching and learning process and development, this should focus on the importance of a teacher competency standard in educational process and student assessment such as philosophy of education goals, defining curriculum content and textbooks under consideration, identifying objectives and analysing their content, and knowledge of their learning styles.

On the other hand, many previous studies and literature confirms the significance of effective participation and collaboration by students in supporting the effectiveness of the learning process. The evaluation of collaboration needs a radical rethinking of approaches and methodologies. In this context (Swan et al. 2006, p. 46-47) pointed to three main issues that are involved in the assessment process:

- The variety and kinds of goals for collaborative learning: these include distinguishing between the teacher who built the learning goals for his or her students

on a collaborative basis, and between the teacher who built it on a competitive basis, or individually. In addition, collaborative learning should distinguish between students who work in the form of learning groups, or conventionally, and among the students who work in the form of co-operative learning groups. Furthermore, collaborative learning should distinguish between each element of the basic elements of co-operative learning that have been implemented in the successful image. In some collaboration activities, learning to collaborate is seen as an important part of what is to be learned; in others, it is merely a means to an end. In some collaborative activities, collaboration is focused on producing a group project, in others it is designed to improve the quality of individual work.

- Other issues refer to the complication of evaluating individual and group behaviours, where collaborative learning represents a complicated activity and to support collaboration, individual and group aspects must be evaluated.

According to Swan et al, (2006), the main building block of successful collaborative learning is integrated between the objectives of collaborative learning on one hand and the goals of the learners on the other hand. However, to ensure the continued success of a collaborative learning strategy, it should succeed on an individual level. An example of this type of evaluation according to Swan et al is using summative testing to give each student a grade based on some combination of their test score and the average score for their group. Another frequently used scheme is to give a common assessment for a group project and have group members rate their peers' contributions, which are then averaged for individual grades.

- Collaboration on assessment itself: assessment for learning achieves its effect and becomes necessary when the practice is rooted in spirit and the heart of the teaching and learning process.

Thus, the teacher uses a package of tools aimed at providing assistance through the presentation of aspects and activities of the collaborative learning plans to find the desired interest such as rebound, questions design and comment trapped correction. In conclusion, particular requirements for collaboration, containing detailed evaluation concentrated on crucial collaborative processes, will assist students achieve the desired aims (Al-kaabi, 2016).

Actually, collaborative learning can be defined as teaching technique, which is invested in the learning process, and can enable more than one leaner (a group of three to five people, a class of twenty to thirty students, a community of hundreds or thousands of people, or even millions of people) to learn something related to studying course material, following a course, problem solving (or other learning activities) or even learning from lifetime work practice together (including several classes of communication, synchronous or non-synchronous, traditional (face to face), common in time or not, computer mediated, common effort or separately (Dillenbourg, 1999 as cited in Al-kaabi, 2016). Moreover, Al-kaabi stated as cited in (Dooly 2008a), collaborative learning requires working together towards a joint aim. This type of learning is also known as collective learning, cooperative learning, peer learning, learning communities, team learning, collaborative learning, or peer teaching. However, collaboration is more than cooperation. Collaboration means the whole process of learning, which consists of students teaching the teacher, students teaching one another and the teacher teaching the students. More significantly, it also means that students have a responsibility towards another learner in addition to themselves, such that achieving collaborative learning method goals involves students assisting each other to learn and understand. Furthermore, in the collaborative classroom, it is primarily through the interactions and relationships between learners

that knowledge is created. Thus, in order to be successful, this learning process needs to pay attention to developing a sense of community among the learners.

2.5.3 Practical approaches to learning

(Mankilik, 2011) explains that practical approach means any teaching and learning activity that involves at some point the students in observing or manipulating real objects and materials. It then means that learning of Physics is incomplete without the acquisition of practical knowledge. Physics, according to (Josiah, 2013) is a practical subject. According to (Dillon, 2008) there are many reasons for doing practical work for scientific subjects in schools. Some of the reasons are to encourage accurate observations and descriptions, to change theories into real-life application, to keep the interest of students in scientific studies and promote a logical and reasoning method of thought. As well, (Bryson, Millar, Joseph & Mobolurin, 2002) argue that practical work helps to improve students' scientific knowledge.

The concepts, principles and laws in Science are practically oriented. Science in itself is a practical subject, therefore, it is veered off its roots if handled theoretically making it very difficult for learners to understand these concepts and principles. The concepts, principles and laws of Science are well understood when they are carried out practically in experiments. Concepts become even simpler to grasp by learners when they are practically carried out. When Science is practicalised, it goes a long way to demystify it.

2.5.4 The Concept of Rectilinear Propagation of Light

According to Greivenkamp and John (2004), geometrical optics, or ray optics, describe light propagation in terms of "rays". The "ray" in geometric optics is an

abstraction or "instrument" which can be used to approximately model how light will propagate. Light rays are defined to propagate in a rectilinear path as far as they travel in a homogeneous medium.

Rays bend (and may split in two) at the interface between two dissimilar media, may curve in a medium where the refractive index changes and may be absorbed and reflected. Geometrical optics provides rules, which may depend on the colour (wavelength) of the ray, for propagating these rays through an optical system. This is a significant simplification of optics that fails to account for optical effects such as diffraction and interference.

It is an excellent approximation, however, when the wavelength is very small compared with the size of structures with which the light interacts. Geometric optics can be used to describe the geometrical aspects of imaging including optical aberration.

Rectilinear propagation of light is a wave property which states that waves propagate (move or spread out) in straight lines. This property applies to both transverse and longitudinal waves even though a wave front may be bent (the wave created by a rock hitting a pond) when the individual waves are moving in straight lines. In the sense of the scattering of waves by an inhomogeneous medium, this situation corresponds to the case n = 1 where 'n' is the index of the material.

In optics the corpuscular theory of light set toward by Sir Isaac Newton (1704) states that light is made up of small discrete particles called "corpuscles" (little particles) which travel in straight lines with a finite velocity and possess kinetic energy. Newton's corpuscular theory rules out the presence of any medium for propagation of light. In its contemporary incarnation, the theory of photons, this idea explains many properties of light, in particular the photoelectric effect. However, it fails to explain

other effects such as interference and diffraction. It was therefore superseded by the wave theory of light, later understood as part of electromagnetism and eventually supplanted by modern quantum mechanics and the wave-particle duality.

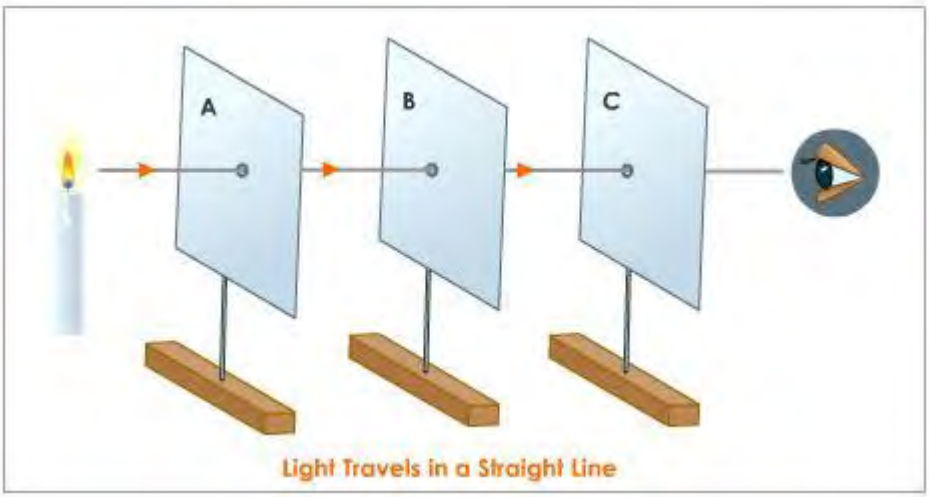
Newton's (1675) theory remained in force for more than a hundred (100 years); that is a century and took precedence over Huygens wave front theory, partly because of Newton's great prestige. However, when the corpuscular theory failed to adequately explain diffraction, interference and polarisation of light it was abandoned in favour of Huygens's wave theory.

Newton (1704) had no problem in explaining rectilinear propagation with his theory. In fact, this property of light provided the supporters (Ibn al-Haytham) of his theory with their strongest arguments against the wave. How could waves travel in straight lines?

A sound could be easily heard around a corner, but light cannot be seen from behind a wall. The former observation is unquestionably wave phenomenon. How can the latter be too? The simple and direct explanation of rectilinear propagation provided by the particle of light model, along with the prestige of Newton, were largely responsible for the preference of the particle theory in the 17th and 18th centuries. According to Abbey, Essiah and Seddoh (1990) light from a source travels in a straight path. This is called rectilinear propagation of light. Light travels very fast. Scientific observation has established that light travels in a vacuum at approximately 3.0×108 m/s. 2.4

2.6.1Experiments to Demonstrate Rectilinear Propagation of Light

According to Arthur Schuster & Edward Arnold (1904), in a homogeneous transparent medium light travels in a straight line and this is known as rectilinear propagation of light. This can be demonstrated by the following experiments.



i. Three cardboards A, B and C are obtained and holes created at their centres

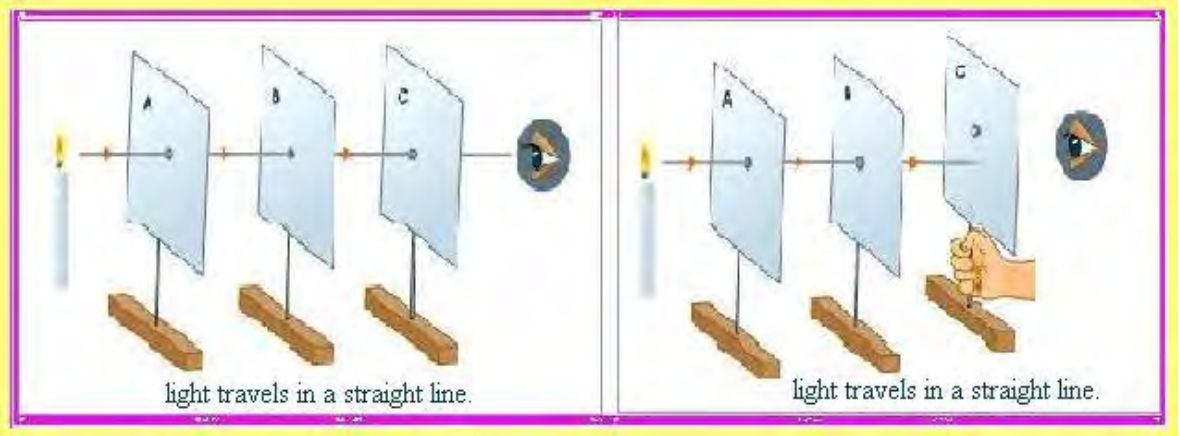
ii. The cardboards are then arranged in such a way that the three holes are in a straight line. This can easily be done with the help of a string, by passing it through the three holes to make the cardboards appear in a straight line. A source of light (burning candle) is placed behind the first cardboard that is A. The string is then removed.

iii. It would be observed that the candle flame (light) would be visible through the hole of the cardboard C; this is illustrated in the diagram above.

iv. Now, slightly displace any one of the cardboards and try to see the flame (light) through the hole of the cardboard C again, this is illustrated in the diagram below.

v. It would be observed that the flame (light) would not be visible (seen).

vi. From this experiment, it is clear that light travels in a straight line.



In order to demonstrate that straight lines of light exist between "the surface of the eye" and "each point on the scene surface of the object". Ibn al-Haytham states that an "accurate experimental examination of this fact may be easily made with the help of rulers and tubes". He describes how an observer looking through a straight tube can only see part of an object lying directly across from the opening of the tube.

If he covers any part of the opening, then there will be screened off at only that portion that lies on a straight line with the eye and the screening body, this straightness being secured by the ruler and the straightness of the tube. It follows from this experiment that with a necessity that dispels doubt, that light does not perceive any visible object existing with it in the same atmosphere, this perception being not by reflection, except through straight lines alone that can be imagined to extend between the surface of the object and the surface of the eye. Light does not perceive any visible object unless there exists in the object some light, which the object possesses of itself or which radiates upon it from another object.

According to Peter & Simpi (2007), rectilinear propagation of light can be demonstrated through the experiment as follows:

a. Three cardboards A, B and C with a hole in their centres are arranged in a straight line by passing a string through.

b. The string is then removed.

c. A source of light for example a candle is placed behind the first cardboard.

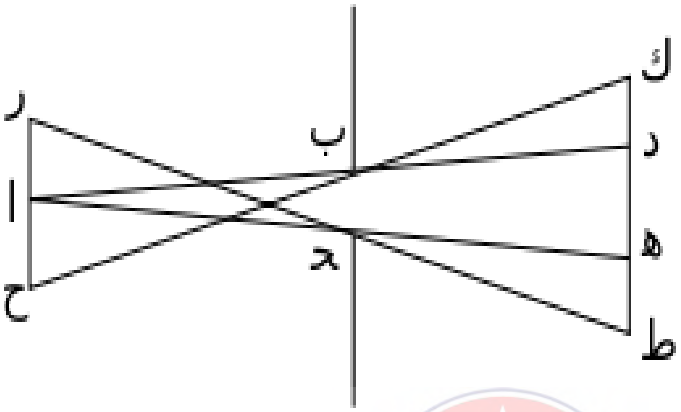
After the experiment it was observed that the light can be seen through the third cardboard. However, on shifting one of the cardboards slightly away from the line, the light is cut off from reaching the observer behind the third cardboard.

2.6.2 Application of Rectilinear Propagation of Light

Ibn al-Haytham (1021) in his various experiments, used the term "al-Bayt al-Muthlim" (Arabic), translated in English as a "dark room" to describe the camera obscura. While earlier philosophers such as Mozi, Aristotle, Theon of Alexandria and Al-Kindi (Alkindues) described the effects of a single light passing through a pinhole camera, none of them suggested that what is being projected onto the screen is an image of everything on the other side of the aperture. Ibn al-Haytham was the first to demonstrate this with his lamp experiment where several different light sources are arranged across a large area, and he was thus the first scientist to successfully project an image from outdoors onto a screen indoors with a camera obscura.

This fact may be easily examined experimentally at any time in the following ways. Let the experimenter employ a chamber with a two-panel door in a dark night, and let him bring several lamps, which he should set up at different points in front of the door. The experimenter should enter the chamber. Close the door but leave a small

gap between the panels, and observe the wall opposite the door. On it, he will find separate lights in the same number as the lamps which have entered through the opening at the door, each facing one of those lamps. If the experiment then screens one of the lamps, the light facing it will vanish, and upon him lifting the screen, that light will return.



If he covers the opening at the door, leaving only a small aperture facing the lamps, he will again find on the chamber's wall the separate lights in the number of those lamps, all according to the magnitude of the aperture.

All the lights that appear in the dark place have reached it through the aperture alone, and therefore the lights of all those lamps have come together at the aperture, and then separated after passing through it. Thus, its lights blended in the atmospheres, the lights of the lamps meeting at the aperture would have mixed in the air at the aperture and in the air preceding it before they reached the aperture, and they would have come out so mingled together that they would not be subsequently distinguishable. We do not however, find the matter to be so; rather the lights were found to come out separately, each being opposite the lamp from which it has arrived.

Ibn al-Haytham (1021) theorised on the rectilinear propagation and finite speed of light. He argued that light is a "substantial matter" the propagation of which requires time "even if this is hidden to our senses." He argued that its "forms" (or "species" in

the Latin translation) were dimensional, and on this basis, he "demonstrated that the perception of light required time: light entering a darkened chamber would have to pass through a dimensional aperture, which could only be opened temporally". In an experiment, he undertook with the camera obscurer in order to establish that light travels in time and with finite speed, he states:

If the hole was covered with a curtain and the curtain was taken off, the light travelling from the hole to the opposite wall will consume time.

He reiterated the same experience when he establishes that light travels in straight lines. The most revealing experiment that indeed introduced the camera obscurer was in his studies of the half-moon shape of the sun's image during eclipses, which he observed on the wall opposite a small hole made in the window shutters. In his famous essay "on the form of the Eclipse", he commented on his observation. The image of the sun at the time of the eclipse unless it is total demonstrates that when its light passes through a narrow round hole and is cast on a plane opposite to the hole it takes on the form of a moon-sickle. In his experiment of the sun light he extended his observation of the penetration of light through the pinhole camera to conclude that when the sun light reaches and penetrates the hole it makes a conic shape at the points meeting at the forming later another conic shape reverse to the first one on the opposite wall in the dark room. This happens when sun light diverges from a point until it reaches an aperture and is projected through it onto a screen at the luminous spot. Since the distance between the aperture and the screen is insignificant in comparison to the distance between the aperture and the sun, the divergence of sunlight after going through the aperture should be insignificant. In other words, should be equal to. However, it is observed to be much greater when the paths of the rays that form the extremities are retraced in the reverse direction. It is found that

they meet at a point outside the aperture and then diverge again towards the sun. This was indeed the first accurate description of the camera obscurer phenomenon.

In camera terms, the light converges into the room through the hole transmitting with it the object(s) facing it. The object will appear in full colour but upside down on the projecting screen/wall opposite the hole inside the dark room. The explanation is that light travels in a straight line and when some of the rays are reflected from a bright object pass through the small hole in thin material they do not scatter but cross and reform as an upside down image on a flat white surface held parallel to the hole. Ibn al-Haitham established that the smaller the hole is the clearer the picture.

2.6.3 Summary of Related Literature

This section has reviewed existing literature on the concept of rectilinear propagation of light, experiments to demonstrate rectilinear propagation of light and the application of rectilinear propagation of light. From what has been reviewed, it is clear there has already been a lot of research into the Rectilinear Propagation of light concerning its concept, and experiment to demonstrate it and the application of rectilinear propagation of light such of the camera obscura (pinhole camera). However, even though some studies have been carried out about Rectilinear Propagation of light, girls of St Anne's Junior High Schools in Bongo still find it difficult to demonstrate this principle through experimentation, hence the need to revisit the problem. In order to critically analyse this problem, it has been important to gather the views of other researchers.

CHAPTER THREE

METHODOLOGY

3.0 Overview

This chapter deals with the research design, population, sampling techniques, instrumentation, data collection processes, data analysis and ethical issues.

3.1 Research Design

Research design is the procedures for collecting, analysing, interpreting and reporting data in research studies' (Creswell & Plano Clark, 2007) as cited in Lelissa, (2018, p. 58). It is the overall plan for connecting the conceptual research problems with pertinent (and achievable) empirical research. In other words, the research design sets the procedure on the required data, methods to be applied, collect and analyse the data and how all of these are going to answer the research questions (Grey, 2014 as cited in Lelissa, 2018). Descriptive research design (Ben, 2018) can provide an in-depth view of any topic to study and the level of detail that can be found in descriptive study is extremely valuable.

The design used is descriptive survey that employed the quasi- experimental research design specifically Pre-test, Post-test control group design. The study used the Pre-test and Post-test non-randomised control and experimental groups to assess effect of practical work on Junior High School learners.

3.2 Population

According to (Taylor, 2019), in statistics, the term population is used to describe the subjects of a particular study- everyone or everything who is the subject of a statistical observation. Taylor asserts that a statistical population is any group of individuals who are the subject of a study, meaning that almost anything can make up a population so long as the individuals can be grouped together by a common feature,

or sometimes two common features. There are, of course, certain limitations with studying populations, mostly in that it is rare to be able to observe all of the individuals in any given group (Taylor, 2019).

A target population (Windhan, 2019) is simply the group of individuals you have selected to study or research. Windhan asserts that, the target population is whom the researcher wants to study. Therefore, the target population of this study was all Junior High School pupils of the school.

Accessible population (Ford, 2021) is the population in research to which the researcher can apply his or her conclusions; study population (also known as accessible population) is the actual sampling frame, from which we randomly draw our sample. The accessible population therefore, was all Junior High School pupils of the school.

3.3 Sampling procedure

Purposive sampling technique was used to select two intact Integrated Science classes- A and B to take part in the study. Each of the classes had 37 pupils totalling 74. One was used as control (Group A) and the other as experimental (Group B).The researcher selected 37 pupils for each group.

3.4 Instruments used

Two test instruments were used- the Pre-test and Post-test both based on Rectilinear Propagation of Light. A second instrument used was a questionnaire to find out attitudes of students towards the use of practical, hands-on activities during lesson(s).

3.5 Validity of the instrument

The concept of validity was formulated by (Kelly, 1927, p.14 as cited in Saul, 2013) who states that a test is valid if it measures what it claims to measure. The test

instruments and questions were both face and content validated, first by colleague teachers of my school and secondly by my supervisor.

Face validity also called logical validity, is a simple form of validity where one applies a superficial and subjective assessment of whether or not his or her study or test measures what it is supposed to measure. It refers to the transparency or relevance of a test as it appears to test participants. Face validity in Science helps to the quality of standards high. The reviewer to determine face validity says they think the process that the researcher plans to take looks like it is a good design.

Content validity on the other hand, assesses whether a test is representative of all aspects of the construct. To produce valid results, the content of a test, survey or measurement method must cover all relevant parts of the subject it aims to measure Glen, (2022).

3.6 Reliability of the instruments

Reliability refers to how consistently an instrument measures something. If the same result can be consistently achieved by using the same methods under the same circumstances, the measurement is considered reliable.

After obtaining responses from pilot tests, the reliabilities of the test items were verified using test-retest procedure. The reliability coefficient for both Pre-test and Post-test were 0.736 and 0.751 respectively. The reliability of the students' attitude questionnaire was verified by examining the Cronbach Alpha reliability coefficient and was found to be approximately 0.7 using Statistical Package for Social Sciences (SPSS) software. The results showed that the items on the instruments had good internal consistencies and therefore capable of measuring what they purported to measure.

3.7 Data collection procedure

Pupils from the two intact classes were considered first, distributed to the control, and experimental groups. A pre-test on Rectilinear Propagation of Light was administered to both groups as a graded assessment tool to determine their preliminary knowledge and skills before applying the different teaching approaches. The results are captured in chapter 4.

Thereafter, an expository teaching approach and practice –based collaborative learning were respectively applied to the control and experimental groups. In all circumstances, the measurement of performance was conducted to measure the extent to which teaching methods influenced the Science lessons. (Hinneh, 2017).

Topics of specific lessons planned and teaching and learning materials used for the experimental group in two units on Rectilinear Propagation of Light were:

1. Rectilinear Propagation of Light – 3 plywoods, table, nail, thread, candles and matches.

2. Formation of shadows- Big ball, small ball, torch light.

Intervention activities.

3.8 Data analysis technique

A descriptive analysis using percentages was used to address the research questions. This was done using SPSS software to report the findings.

3.9 Ethical issues

A letter of introduction was obtained from the Graduate Coordinator of the programme and used to seek permission from the Headmistress and Assistant Headmistress to use the learners for the study. No names of learners were required on the questionnaire and this helped in preventing individual views expressed on the questionnaire and test.

4.3 Intervention activities

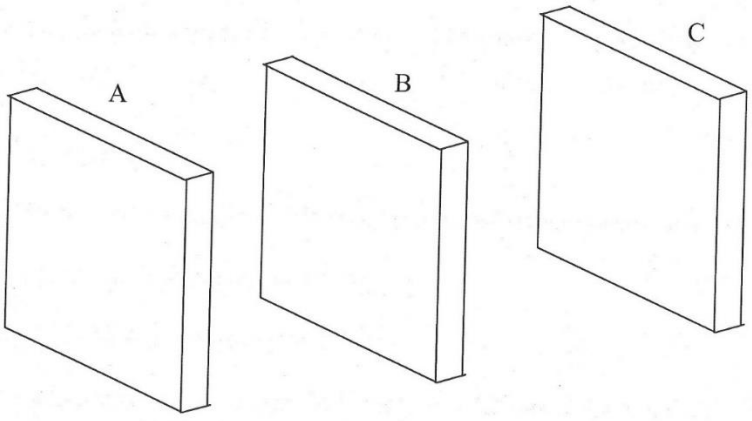
In the next week, the researcher then prepared lesson and teaching notes and then used it and taught lessons (Rectilinear Propagation of Light) to Group A using the Traditional Method of teaching. Here, the researcher only employed the teacher-centred, the teacher-led discussion and the lecture teaching approaches for the lessons. The members (learners) of this group did not perform any practical nor hands-on activities during the lessons neither were they put in groups. Thus, concepts were only explained to learners abstractly with learners having to do individual learning. The researcher only demonstrated the concept of Rectilinear Propagation of Light using chalkboard and textbook illustrations, popularly known as 'talk and chalk' method.

Next, the researcher begun the treatment process to the Experimental Group (Group B). The pupils were first put into six (6) groups, these groups were named collectively by the researcher and the learners as 'teams' with each team consisting of six (6) pupils with only one team having seven members in their team. The learners were carefully taken through the characteristics of the Collaborative approach of teaching and learning as earlier stated at the beginning of this study.

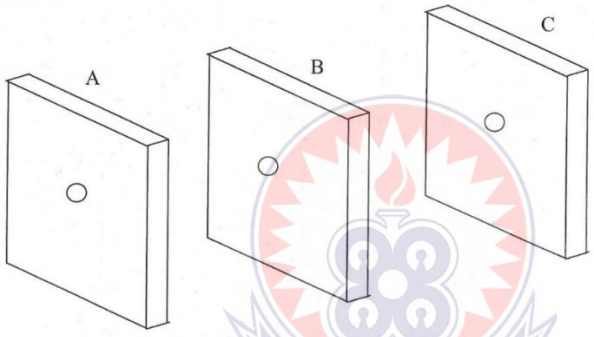
The researcher then taught the teams by applying the practical approach and hands-on activities teaching techniques using the Model (TLMs) to teach the concepts of Light Travels in a Straight Line and Shadow Formation under the topic: Rectilinear Propagation of Light. Below is the illustrations of how the researcher used the constructed Model (TLMs) to demonstrate the concepts.

The Model (TLM) was constructed as follows:

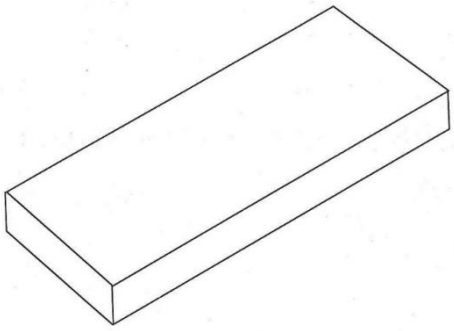
• Three plywoods of the size A, B and C are shaped in the form of a square measuring 10cm by 10cm.



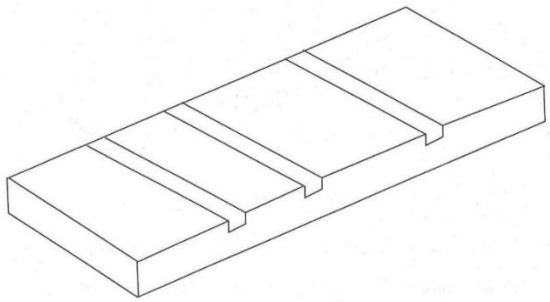
- A 6-inch nail is used to bore a hole in the middle of all the three plywoods, creating a circumference of about 0.2mm.



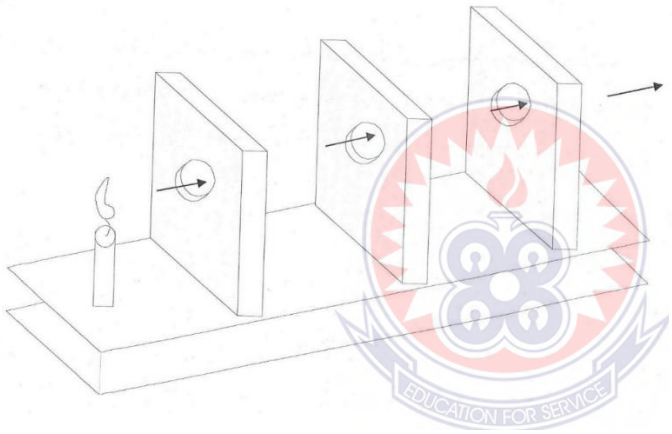
• A board of about 38cm long and a width of about 70cm is used as a base for the three plywoods.



The base board is slightly cut (about ½mm deep) across the length three times and each cutting should be 10mm away from the other, making the cuttings to be equidistance from each other.

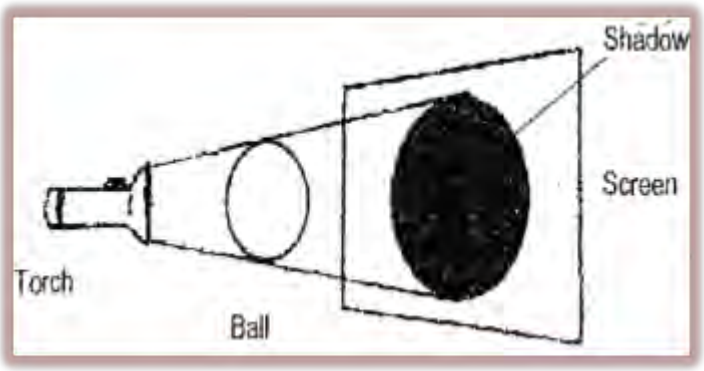


The plywoods (A, B and C) are then arranged in a straight line (considering the holes) on the baseboard by inserting them in between the cuttings on the baseboard and a source of light (candle) placed behind the first plywood.



The researcher then gathered the Experimental Group (the treatment group) and took them through on how to demonstrate that light travels in a straight line with the aid of the Model that had been constructed.

Another lesson was scheduled by the researcher and took the Experimental group through practical and hands-on demonstration of the second experiment; Shadow Formation. Here, the researcher used a big ball, a torch light and a screen (a 20 cm square board). Below is a set-up apparatus showing the concept of Shadow Formation that was carried out by learners during the intervention.



CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.0 Overview

This chapter looks at the results and findings of the research obtained from administration of the Pre-test, Post-test items and the questionnaire responses of pupils of both Control and Experimental groups, represented as Groups A and B respectively. Besides, it also deals with the presentation of analysis and discussions of the results of the data obtained during the study.

4.1 Introduction

The purpose of this study was to use a Model (TLMs) to assist female Junior High School pupils improve academic performance on Rectilinear Propagation of Light in Integrated Science using Collaborative approach in teaching and learning in conjunction with practical approaches and hands-on activities. The research objectives were to:

1. determine the effectiveness of a Model (TLMs) with Collaborative techniques of teaching and learning on the academic performance of female Junior High School students in Integrated Science in Bongo.

2. compare the difference in performance between girls taught using the Traditional method and the Collaborative teaching techniques in Rectilinear Propagation of Light.

3. examine Junior High School girls' attitude towards collaborative learning approach in Rectilinear Propagation of Light in Integrated Science.

The study sought to find answers to the following research questions:

1. What is the effect of using a Model (TLMs) with Collaborative learning approaches on Junior High School girls' performance in Rectilinear Propagation of light?

2. What is the difference in performance between girls taught Rectilinear Propagation of Light using Collaborative technique and their counterparts taught using the Traditional Method?

3. What is the attitude of Junior High School girls towards collaborative teaching and learning technique?

4.2 Pre-intervention

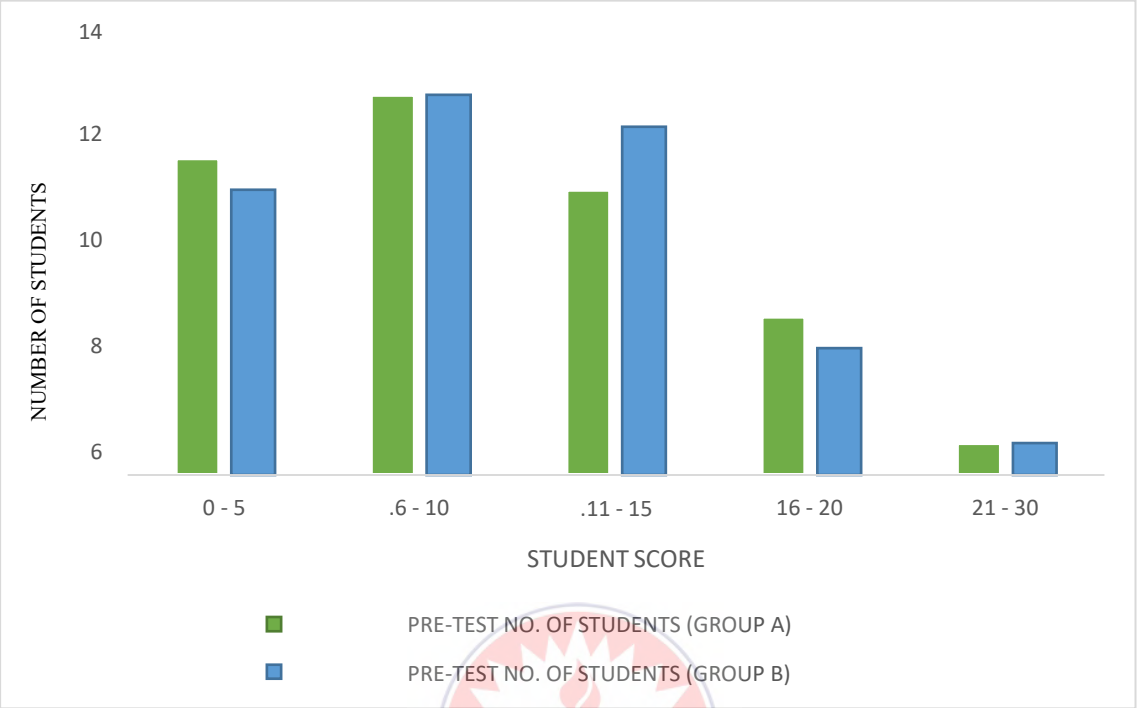
The researcher began the Pre-intervention stage by organising a pre- intervention test for both the Control and the Experimental groups without any form of teaching. This the researcher did to ascertain the problem actually existed. The researcher administered the test herself to ensure independent work from learners. The test items were prepared using the prescribed Integrated Science syllabus and other relevant books. The test items were also based on the selected Physics topics: Rectilinear Propagation of Light; 1. Light travels in straight lines. 2. Shadow formation. In all, there were 2 practical questions, 5 theory questions and 10 multiple-choice questions divided into parts A, B and C respectively with each part scored out of 10, making it a total of 30 marks in all with the pass mark being 15.

Table 4.1 shows the pre-intervention test scores of pupils of Groups A (Control Group) and B (Experimental Group).

Pre-Test Scores	Group A N	%	Group B N	%
0-5	10	27	9	24
6-10	12	32	12	32
11-15	9	24	11	30
16-20	5	14	4	11
21-30	1	3	1	3
Total	37	100	37	100

Quantitatively, the results from Table 1 indicated that ten (10) students representing 27% and nine (9) students representing 24% in Groups A and B respectively obtained total scores within the range of 1-5. Twelve (12) students representing 32% in Group A and twelve (12) students representing 32% in Group B had their total scores within the range 6-10. Also nine (9) students representing 24% in Group A and eleven (11) students representing 30% in Group B obtained total scores within the range 11-15. Within the range 16-20 scores, five (5) representing 14% and four (4) students representing 11% in Groups A & B respectively obtained scores in that range. Only one (1) student representing 3% in Group A and one (1) student representing 3% in Group B got a total score within a range 21-30. The results indicated that sixty three (63) of the students representing 85%, thirty one (31) students representing 42% in Group A and thirty two (32) students representing 43% in Group B, out of a total of seventy four (74) students selected for the study obtained scores from 1 to 15 marks. Just eleven (11) students representing 15%, six (6) representing 8% in Group A and five (5) representing 7% in Group B out of a total of seventy-four (74) students obtained scores above fifteen (15) which was supposed to have been the pass mark.

Figure 4.1: Bar Chart Showing Pre-test Scores of Students in the Control (Group A) and Experimental Group (Group B)



Bar chart in Figure 1 above compared the pre-test scores of students in Groups A and B. The results showed that students' performances were almost the same.

In addition, the pre-test scores of both Groups A and B were compared using the unpaired t-test to find out if there was any significant difference between the achievements of the two groups in the concept of Rectilinear Propagation of Light. This was because the results presented in the chart do not tell the significant difference in achievement between the two groups.

Table 4 . 2: Unpaired Samples t-test of Pre-test Scores of Control (Group A) and Experimental (Group B) Groups.

Group	N	μ	SD	df	t-value	p-value
A	37	9.11	5.36	72.00	1.99	0.93
B	37				9.00	5.29

Table 2, shows an independent sample t-test which was conducted to compare the achievement of Pre-test Scores of Groups A and B before the use of the Model that is, the TLMs with Collaborative teaching learning approaches. The scores obtained were Group A; mean = 9.00, SD = 5.29 and Group B; mean = 9.11, SD=5.36. The t-calculated was 1.99 at P > 0.05 and df of 72. The results from Table 1 showed that there was no significant difference between the mean scores of the two groups; A and B before both groups were taught using the Traditional Method of teaching and Collaborative Teaching and Learning approaches respectively. Since there was no significant difference between the two groups, it meant that the learners' achievement in the topic: Rectilinear Propagation of Light before the interventions was the same. Hence, the researcher rejected the null hypothesis (Ho 1) that, there is significant difference between the means of pre-test scores of girls of the Control Group (Group A) and girls of the Experimental Group (Group B) before using Traditional Method teaching techniques and collaborative teaching and learning techniques respectively.

Even though different teachers taught the students, the topic Rectilinear Propagation of Light before the researcher started her study, yet the study indicated that their level of achievement in the Rectilinear Propagation of Light concepts was the same. This meant that irrespective of the fact that they were taught the concept of Rectilinear Propagation of Light, had common difficulties in understanding the concepts. Thus, the confirmation that the problem of poor performance in Integrated Science most especially in the Physics aspect existed amongst learners. The low achievement of the students in the concepts at the pre-test level could be attributed to the abstract nature by which most Integrated Science teachers teach concepts, hence the difficulties for the learners to attain high achievement. Aside determining whether there was any significant difference between the two groups in terms of the students achievement in

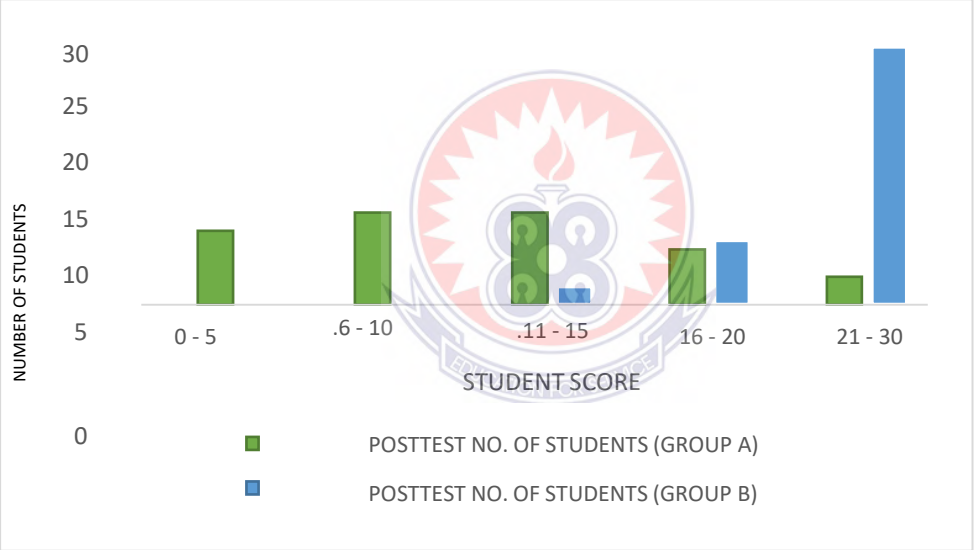
the concept of Rectilinear Propagation of Light based on their relevant previous knowledge, the Pre-test also set the pace for determining the effectiveness of the Traditional Method of Teaching and Learning technique and the use of the Model with Collaborative Teaching and Learning approaches on the students' achievement in concept of Rectilinear Propagation of Light, which was paramount to this study. The performance in terms of achievement between the two groups was statistically the same. This therefore formed the basis for using the two groups as the Control (Group A) and Experimental (Group B) groups.

A post-intervention test was then administered to both groups; the Control (Group A) and Experimental (Group B) groups using the same test items. This was to determine whether there was a difference between the academic achievement of pupils taught using a Model with Collaborative learning approaches and pupils taught using the Traditional teaching approach on Junior High School girls' performance in Rectilinear Propagation of Light and if there was, how significant the difference was. The post-intervention test scores of both groups were analysed quantitatively. It was observed that, there was difference between the means. The researcher then went further and used the independent unpaired sampled t-test to determine how significant the difference of the means was. Table 3 and figure 1 show the statistical report and graphical representation respectively of the post- intervention test of both groups.

Table 4. 3: Post-intervention Test scores of Groups A and B

Marks	Group A	%	Group B	%
	N		N	
0-5	8	22	0	0
6-10	10	27	0	0
11-15	10	27	2	5
16-20	6	16	7	19
21-30	3	8	28	76
Total	**100**	**37**	**37**	**100**

Figure 4. 2: A bar chart showing Pre and Post Tests scores of Groups A and B



4.4 Discussion of Research Questions

1. **Research Question 1:** What is the effect of using a Model (TLMs) with Collaborative learning approaches on Junior High School girls' performance in Rectilinear Propagation of light?

   To answer the above research question, the researcher put the Experimental group (Group B) members in teams with each team consisting of six (6) pupils with only one team having seven (7) members (one of the major features of

Collaborative teaching and learning). The learners of this group were then taken through the rest of the characteristics of the Collaborative Teaching and Learning Approach as stated earlier in this study (Chapter 2). The treatment was then given by teaching and taken them through the practical and hands-on activity demonstration of the concepts of Rectilinear Propagation of Light through experiments using the Model. From table 3, the increase in value of the mean score of the Experimental group (Group B) indicated that, there was an effect of using Collaborative Teaching and Learning Approach on Junior High School girls' performance in Rectilinear Propagation of light. This increase in value of the mean score of Group B clearly showed from Table 3 that, majority of pupils in Group B understood the concepts well and also demonstrated these concepts through experiments collaboratively because they (Group B) were taught using the Model (TLMs) with Collaborative practical approaches to teaching and learning, thus the increase in their mean score and hence the effect of using the Model (TLMs) with Collaborative learning approaches on Junior High School girls' performance in Rectilinear Propagation of light. Whiles that of the mean score of their counterparts, the Control group that is, Group A remained low, which the researcher attributed to the fact that they (Group A) were taught using the Traditional Method of teaching and learning technique, thus, the low mean score. Therefore, the researcher concluded that there was an effect of using a Model with Collaborative Teaching Learning Approach on Junior High School girls' performance in Rectilinear Propagation of light.

Research question 2: What is the difference in performance between girls taught Rectilinear Propagation of Light using Collaborative technique and their counterparts taught using the Traditional Method?

This question sought to find out the difference in academic achievement between the Control group (Group A) that was taught using the Traditional Method of teaching and learning and that of the Experimental group (Group B) that was taught using the Collaborative Teaching and Learning approaches. Here, the researcher administered a post-intervention test for both groups A and B after they (the groups) were taught using the Traditional Method of teaching and the Collaborative Approaches to learning with practical and hands-on activities respectively. From Table 3, it was revealed that considering the results of the study (Table 3), quantitatively, whereas in Group A, eight (8) representing 22%, ten (10) representing 27% and ten (10) representing the same 27% of students obtained total test scores within the ranges of 1-5, 6-10 and 11-15 respectively, no student representing 0% had a total score within the ranges of 1-5 and 6-10 in Group B. Only two (2) students representing 5% got their total scores within the range of 11-15. Six (6) representing 16% and seven (7) representing 19% of students had their total scores within the range of 16-20 in groups A and B respectively. On the other hand, as many as twenty eight (28) students representing 76% (out of a total of thirty- seven) obtained total scores within the range of 21-30 in Group B while in Group A only three (3) students representing 8% (out of a total of thirty- seven) had total scores within that same range. Comparatively, nine (9) students representing 24% obtained total scores above fifteen (the pass mark) in Group A, whilst as many as thirty–five (35) students representing 95% got total scores above fifteen in Group B.

The bar chart in Figure 2 above compared the test scores of students in Groups A and B for post-test intervention. The results showed that students in Group B performed better than that of students in Group A.

The unpaired samples t-test was used to determine the significant difference in achievement in the concept of Rectilinear Propagation of Light between the students in Group B and the students in Group A using the Model with practical collaborative approaches to learning and the Traditional Method of teaching technique respectively. The results indicated that the students in Group B had higher achievement in the concept of Rectilinear Propagation of Light than their Group A counterparts since the mean score of Group B was significantly higher than the mean score of Group A (p =1.2×10^{-15}). The results showed that the treatment using the Model with Collaborative teaching and learning approaches yielded significantly higher achievement of students than the treatment using the Traditional Method of teaching technique (Table 4). Since there is significant difference between the means, the researcher therefore rejected the null hypothesis (Ho 2) that, there is no significant difference between the means of post-test scores of girls taught using a Model with Collaborative Teaching and Learning technique and those taught using the Traditional Method of teaching in Rectilinear Propagation of Light.

Table 4. 4: Unpaired t-test of Post-test Scores of Groups A and B

Group	**N**	**μ**	**SD**	**df**	**t-value**	p-value
A	37	10.51	5.73	72	1.99	1.2×10^{-15}
B	37	22.49	4.24			

$p<0.05$, df =72

4.5 Conclusion

Comparatively, from the two tests that is, pre and post intervention tests of the two groups, it was observed that pupils of Group B (Experimental Group) performed extremely well in the post –Intervention test as illustrated in table 4 as they understood the lesson better with the aid of the Model (T.L.Ms) and hence were able to answer the questions, that is, post-test with relative ease. Counting on the above evidence, the researcher confidently concluded that the intervention was very successful since much improvement was realised after the data collected were analysed critically.

Burke, (2011) on advantages of working in groups, emphasised that groups stimulate creativity, help people remember group discussions better, foster learning, comprehension, and decisions that students help make yield greater satisfaction. The results of the study also agreed with the study of Akar (2005), which posited that the constructivist approach to teaching enables students to perform better in achievement test than the traditional lecture method. This is because the students in the constructivist group have the opportunity to benefit from discussion and interaction with peers than the Traditional teaching Method.

Research question 3: What is the attitude of Junior High School girls towards collaborative teaching and learning technique?

This research question aimed at finding out the views of Junior High School girls about the collaborative teaching and learning approaches. This the researcher did by providing a questionnaire to the participants. A five-point Likert scale ranging from 'Strongly Agree to Strongly Disagree was used. The data were analysed by calculating the percentages of the answers for the 5-point Likert scaled statement. The questionnaire consisted of 15 questions.

The responses of the students were analysed using a descriptive statistics such as frequency and percentage. All the responses from individual students about their views concerning the use of Collaborative approaches to learning to teach the selected topics were analysed. Table 5 shows the results of the number of students and the extent to which they agreed on each item in the questionnaire. The Likert scale used were SA=Strongly Agree (1), A=Agree (2), N=Neutral (3), DA=Disagree (4), SD=Strongly Disagree (5). The mean value and the standard deviation (STD) on this scale for each questionnaire item were determined. The percentage of students on each agreement level is presented with each number of students in parenthesis.

Table 4. 5: The attitudes of Junior High School girls towards collaborative teaching and learning technique

S/N	ITEM	SA 1	A 2	N 3	DA 4	SD 5	MEAN	STD
1.	Collaborative Learning helped me improve my performance in Rectilinear Propagation of Light.	(36) 97.3%	(1) 2.7%	0	0	0	1.03	0.16
2	Group learning aroused and sustained my interest in Rectilinear Propagation of Light	(33) 89.2%	(4) 10.8%	0	0	0	1.00	0. 0
3	I was motivated to learn when Collaborative Learning Approaches were used in teaching Rectilinear Propagation of Light.	(37) 100%	0	0	0	0	1.10	0.30
4.	Collaborative Learning Approaches made me understood Rectilinear Propagation better.	(25) 68%	(11) 30%	(1) 3%	0	0	1.73	0.55
5	5. I collaborated with other student during group discussions.	(20) 54%	(11) 30%	(6) 16%	0	0	4.68	0.61
6	I was actively engaged during group instructional lessons.	(24) 65%	(10) 27%	(3) 8%	0	0	1.08	0.47
7	Collaborative Learning catered for my learning styles in class.	(33) 89%	(4) 11%	0	0	0	1.40	0.50
8.	When I work with other students I Achieve more than when I work alone.	(22) 59%	(14) 38%	(1) 3%	0	0	1.43	0.55
9.	Collaborative learning enhances class participation.	(21) 57%	(14) 38%	(2) 5%	0	0	1.48	0.60
10	Creativity is facilitated in the group setting.	(27) 73%	(9) 24%	(1) 3%	0	0	1.38	0.63
11	Group activities make the learning experience easier.	(25) 68%	(11) 30%	(1) 3%	0	0	1.65	7.3

12.	I prefer individual learning (not grouped learning than grouped	0	0	(3) 8%	(10) 27%	(24) 65%	1.48	0.64
13.	I learned to work with students who are different from me	(28) 76%	(7) 19%	(1) 3%	(1) 3%	0	1.38	0.67
14.	I prefer that my teachers use more group learning activities / assignments	(32) 86%	(5) 14%	0	0	0	1.18	0.38
15.	I eagerly look forward in anticipation to the next lesson because of Collaborative Learning.	(34) 92%	(3) 8%	0	0	0	1.32	0.47

As seen in Table 5, thirty-seven (37) students gave their responses about the effect of Collaborative Learning Approaches in lesson presentation to the questionnaire. In item1, students were to respond to whether or not Collaborative Learning Approaches to teaching improves their performance, thus, knowledge in the selected topics in Rectilinear Propagation of Light Concepts. According to the students' responses, 97.3 % of them strongly agreed and 2.7 % only agreed that the Collaborative Approaches to Learning did improve their performance, in the topics. Thus, all the students were in agreement with the statement. In terms of whether Collaborative Approaches to learning motivated students to learn or not, it was observed that, all the students strongly agreed that it did motivate them. The next item was to find out whether the students interest were aroused and sustained during the lesson when a concept was taught in different modes of instruction 68%, 30% and 3% of the students strongly agreed, agreed and were neutral respectively that Collaborative Learning Approaches made them understood Rectilinear Propagation better. None of the students was in disagreement with that item. This might imply that all the students did understood something during the use of Collaborative Approaches to learning in teaching the topics in the concept of Rectilinear Propagation of Light.

For item 5, the students who strongly agreed, agreed and those who were neutral were 20, 11 and 6 (54%, 30% and 16%) respectively; this suggested that 54% of the students collaborated effectively during the lessons in Rectilinear Propagation of Light when Collaborative Approaches were used. However, 16% of the students were neutral about the statement. Item 6 sought to find out whether pupils were actively engaged during group instructional lessons in Rectilinear Propagation of Light thus helped them to learn, 65% strongly agreed that they were actively engaged during instructional lessons, 13% agreed they engaged actively and only 8% of the pupils responded neutral to the statement. A pupil neither disagreed nor strongly disagreed.

Again, 89% and 11% of the students strongly agreed and agreed respectively that Collaborative Learning Approaches catered for their learning styles in class. A high percentage (89%) of the students strongly agreed that the use of Collaborative Learning Approaches during teaching and learning catered for their various learning styles in the classroom. This is because majority of the students strongly agreed to the statement that they felt their learning styles were catered for when Collaborative Learning Approaches were used during instructional lessons as they had responded to item 7. Most of the students agreed the group setting facilitated their creativity as requested in item 10. This is because 97% of the students agreed to the statement. Table 5 clearly shows that most of the students would like to cooperate with other students during group discussion.

However, item 12 sought to find out the feelings of pupils towards individual learning which is primarily employed by most teachers when using the Traditional Method of teaching and learning and that of the Collaborative Learning Approaches, interestingly the response trend changed from strongly agree to strongly disagree. This is because none of the students strongly agreed that the use of individual learning

(non-grouped) of instructional lessons helped them to learn. However, 8% of the students were neutral, whiles 27% and 65% students disagreed and strongly disagreed respectively. This implies that 92% of the students totally had disinterest in the use of individualised learning during instructional lessons. With respect to the response to item 14, an excellent percentage score of 86% of the students strongly agreed with 14% agreeing that they prefer their teachers to use more group activities in instructional lessons. This means that all the pupils enjoy activity learning in groups than learning individually. It also suggests that, academic achievement can be enhanced when pupils are actively engaged in-group learning. It is evident from Table 5, that 100% of the respondents agreed to the statement that they were eagerly anticipating the next lesson to be delivered in Collaborative Learning Instructional Approaches.

The findings of the study credence to the research work of Lagowski, (1990) who conducted a study to find out how much students retain after learning and concluded that students usually retain 10% of what they read; 26% of what they hear; 30% of what they see; 50% of what they see and hear; 70% of what they say; 90% of something they say while they are doing a task.

This study used Cronbach's Alpha to test the consistency of the results produced by the scale. According to Sekaran, (2004) as cited in Al-kaabi, the values of Cronbach's Alpha for each variable of the questionnaire and for the entire questionnaire should exceed 0.60 in order to consider the result acceptable. The higher the value of Cronbach's Alpha is, the greater the consistency of the instrument and the more trustworthy its data. The reliability of the data collected through the pilot study questionnaire was calculated using SPSS, and the value of Cronbach's Alpha was 0.7,

which is considered a good result. This reflects the trustworthiness of the research instrument's data and its high consistency level.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0 Overview

This chapter summarises the main findings of the study and draws conclusions. It also offers suggestions and recommendations in relation to the usage of teaching and learning techniques and/or approaches as well as Teaching and Learning Resources (TLRs) also known as TLMs.

5.1 Summary

The researcher used descriptive survey design for the study with quantitative approach. Purposive sampling was used to select participants (pupils). Pre-tests and Post-tests Interventions as well as structured questionnaire were the main instruments used to collect data for the study. The data were analysed descriptively and presented in tables and charts. The data collected were also analysed statistically using Statistical Package for Social Sciences (SPSS).

5.2 Findings

The study sought to find out the effectiveness of a Model (TLMs) to assist female Junior High School students to demonstrate the concept of Rectilinear Propagation of Light. Collaborative Approaches to teaching and learning with the use of practical and hands-on activities were used as teaching and learning techniques to achieve this aim in order to improve the academic performance of Junior High School Girls in Rectilinear Propagation of Light in Integrated Science using the Model (TLMs).

Pre-intervention findings revealed that the long-practiced teaching approach referred to as Traditional lecture-based Method does not improve the academic

performance of pupils in the concept of Rectilinear Propagation of Light, thus, Integrated Science. Results of this study revealed that the pupils performed poorly in the concept of Rectilinear Propagation of Light when they were taught using the Traditional Method approach as this is evidenced by the results in Table 4. When using the Traditional Method, the teacher dominates in the teaching and learning process. Students' are therefore denied small group approach to learning and deprived the opportunity to constructing their own meanings of concepts learnt, hence they are compelled to memorise these concepts with limited or no understanding.

Post-intervention findings indicated that the treatment using Collaborative Learning Approaches yielded significantly higher academic improvement of pupils in the concept of Rectilinear Propagation of Light than the treatment using the Traditional Teaching and Learning approach. When using Collaborative Teaching and Learning approach, learning is carried out among students in small groups where there is sharing of ideas among group members in the form of discussion which creates room for all members to benefit from whatever is being discussed. Students construct their own meanings of the concepts learnt with high level of retention. Students are self-directed and acquire problem-solving skills to learn among themselves with limited guidance from the teacher (facilitator), who only facilitates.

5.3 Conclusion

The relevance of constructing the Model (TLMs) to teach pupils about Rectilinear Propagation of Light is consultable. It has been able to help the researcher to explain how light travels in straight lines in a very simple manner. The use of the project material has brought about an excellent impact on the teaching and learning of the issue concerning Rectilinear Propagation of Light. The project material has really

helped in the elimination of abstract teaching (teaching without TLMs) as heavily characterised by the Traditional Method of teaching and learning. With the use of the project material, the researcher acknowledged the fact that abstract teaching should be discouraged since pupils learn much better when interacting with concrete materials and more so when put in groups to learn as heavily characterised by the Collaborative teaching and learning technique.

The findings of this study indicated clearly that with the use of the Collaborative teaching and learning approach, the learners were put at the centre of the teaching learning process with the teacher playing a facilitator's role. Learners in groups solved several questions that yielded a better post-test achievement in the Rectilinear Propagation of Light concept than those taught using the Traditional Method of teaching technique. The advantage of working in groups as in the case of Collaborative Learning helped the students to perform better than their counterparts who were taught using the Traditional Teaching and Learning technique where working in groups was less emphasised. The study of Burke (2011) on advantages of working in groups, asserted that group learning stimulates creativity, helps people remember group discussions better, foster learning, comprehension, and decisions that students get yield greater satisfaction. The results of the study also agree with the study of Akar, (2005) which stated that the constructivist approach to teaching enables students to perform better in achievement tests than the Traditional lecture method. This is so because the students in the constructivist group have the opportunity to benefit from discussion and interaction with peers than the Traditional lecture method.

5.4 Recommendations

The researcher made the following recommendations:

Basic school Science teachers, most especially Junior High Schools in the Bongo district should adapt the Collaborative Teaching and Learning technique with other effective teaching and learning techniques such as practical and hands-on activity oriented to teach various topics in Science to enable pupils grasp concepts taught easily.

Integrated Science teachers should use the appropriate and relevant teaching-learning materials for lessons. Thus, the researcher recommends that concrete items such as these project materials (TLMs) should be used in teaching lessons that affect the attitude of pupils. This largely arouses and sustains the interests of students during lessons. Additionally, relevant and appropriate Teaching Materials create room for pupils' easy understanding of concepts.

Integrated Science teachers should help students appreciate the fact that any Physics topic can be learned easily, thus, Science. This could be done by involving the students in every science activity to allow them discover things by themselves which would in turn help erase the perception that, Physics topics are difficult.

5.4 Suggestions for further Research

The researcher based on the findings of this study, made the following suggestions for further research.

Planners of Integrated Science Curriculum should design the Integrated Science syllabus in such a way that there are more practical and hands-on activities with more emphasis placed on group learning (Collaborative learning) among learners.

Ghana Education Service (GES) should regularly provide schools with Teaching and Learning Resources (TLRs).GES and heads of schools should as a priority make funds available for schools to purchase Teaching and Learning Materials (TLMs) promptly.

Government should provide schools with libraries and stock them with teachers recommended textbooks. In addition, Science laboratories with well-stocked science apparatuses as well as Science Resource Centres should be established in basic schools.

Regular In-Service training should be organised for Integrated Science teachers to acquaint them with the current trends of education regarding teaching and learning strategies in Science. This could be done through professional Learning Communities.

In real sense, the simple project material (Model) on Rectilinear Propagation of Light though was used to enlighten pupils on how to demonstrate that light travels in a straight line, the researcher still sees the need for the modification of the product so that it will be most effective in the future. It is therefore expected that more durable materials should be used in the future.

In addition, in the near future the researcher would like the size of the project material be increased than the previous one so that pupils can effectively interact with it more.

Finally, it is suggested that future researchers should construct a pin hole camera to demonstrate the application of rectilinear propagation of light.

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APPENDICES:

APPENDIX A

PRE-TEST ITEMS

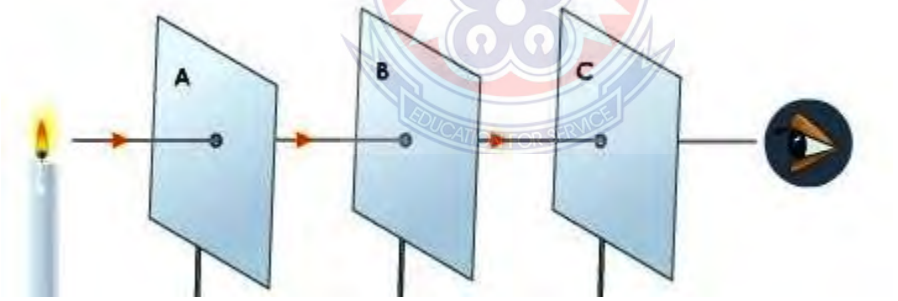
ST ANNE'S JUNIOR HIGH SCHOOL, BONGO DISTRICT

This test is for research purpose only, any information you provide will not be used against you in any way.

This paper is made up of three parts, A, B and C. Answer **all** the questions in each part.

PART A: PRACTICAL (10 MARKS)

1.(a) In an experiment to demonstrate a property of light, three cardboards, A,B and C with holes in their centre are arranged in a straight line between a lighted bulb and an observer as shown in the illustration below.



Study the illustration carefully and use it to answer the questions that follow:

(i) What would the observer see from the position shown?

(ii)What would the observer see when cardboard **B** is slightly displaced from the line?

(iii)Explain the observation made in (ii) above.

(iv)What would be observed when the cardboard **B** is brought back to its original position?

(v)What property of light is being demonstrated in this experiment?

(vi)Mention

α. **two** natural occurrences that could be explained by the property of light demonstrated.

β. **one** device that works on the property of light demonstrated.

PART B (10 marks)

2. Define the term light.

3. State the principle of rectilinear propagation of light.

4. Light does **not** travel in a straight line. True/False

5. The direction of path taken by light is called light ray. True/False

PART C (10 marks)

1. When light travels from glass to air its speed is

A. increased B. reduced C. halved D. unchanged

2. Which of the following statements about shadow formation is correct? It shows that light rays can

A. be diffused B. travel in a straight line C. be refracted D. be refracted

3. The eclipse formed when the moon comes between the sun and the earth is known as

A. annular eclipse B. lunar eclipse C. solar eclipse

4. In a pinhole camera, when the size of the pinhole is increased, the image formed is

A. blurred B. erect C. magnified D. virtual

5. Which of the following statements describes the nature of light?

A. It passes through all objects B. It is absorbed at a polished surface

C. It travels in a straight line D. It is always reflected in a medium

6. A ray of light makes an angle of 20^{o} with the surface of a plane mirror. Determine the angle of reflection.

A. 20^{O} B. 50^{O} C. 70^{O} D. 90^{O}

7. The darkest part of a shadow formed when a large source of light is used is the

A. partial shadow B. lunar eclipse C. umbra D. night

8. Which of the following is an indirect source of light?

A. Torch light B. The sun C. Fire D. Moon

9. Which of the following statements about light is true?

A. Light is reflected from polished surfaces

B. Light travels through opaque objects

C. Light passes through plane mirrors

D. The angle of incidence is between the normal and the reflected ray.

10. Which of the following controls the amount of light that enters the eyes?

A. The cornea B. The iris C. The lens D. The pupil

APPENDIX B

POST-TEST ITEMS

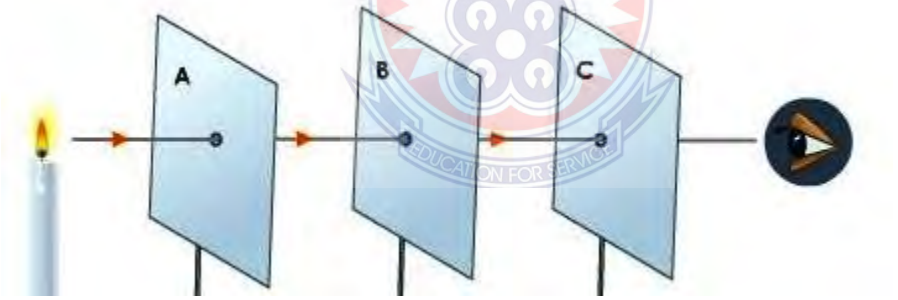
ST ANNE'S JUNIOR HIGH SCHOOL, BONGO DISTRICT

This test is for research purpose only, any information you provide will not be used against you in any way.

This paper is made up of two parts, A and B. Answer **all** the questions in each part.

PART A PRACTICAL (20 MARKS)

1.(a) In an experiment to demonstrate a property of light, three cardboards, A,B and C with holes in their centres are arranged in a straight line between a lighted bulb and an observer as shown in the illustration below.



Study the illustration carefully and use it to answer the questions that follow:

(i) What would the observer see from the position shown?

(ii)What would the observer see when cardboard **B** is slightly displaced from the line?

(iii)Explain the observation made in (ii) above.

(iv)What would be observed when the cardboard **B** is brought back to its original position?

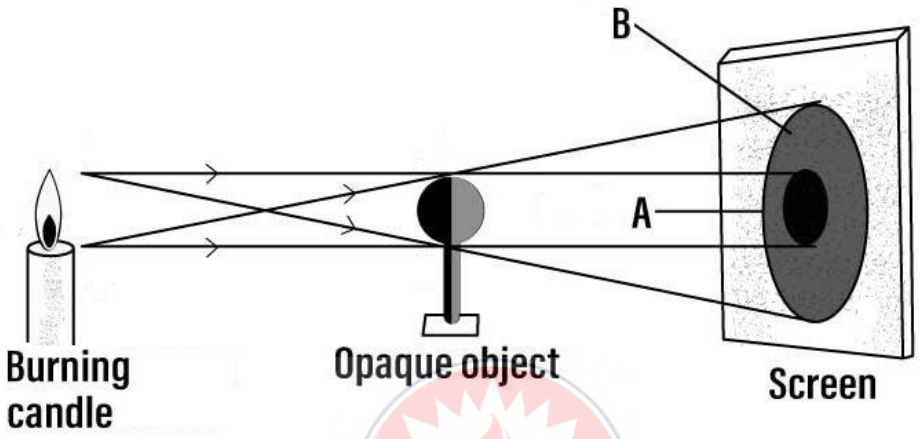
(v)What property of light is being demonstrated in this experiment?

(vi)Mention

α. **two** natural occurrences that could be explained by the property of light demonstrated.

β. **one** device that works on the property of light demonstrated.

1. (b) The diagram below is an illustration of the picture obtained on a screen when an opaque object is placed in the path of a light source.



Study the diagram carefully and answer the questions that follow.

(i) Name each of the shadows that is cast on the screen:

(α) A (β) B

(ii) What does the shadow of the object cast on the screen illustrate?

2. State the principle of rectilinear propagation of light.

3. Define the term light.

4. Light does **not** travel in a straight line. True/False

5. The direction of path taken by light is called light ray. True/False

APPENDIX C

QUESTIONNAIRE

Dear respondent,

This questionnaire is designed to investigate students' attitudes towards Collaborative Learning. Your name is not required therefore; your responses will not be used against you in any way. 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:

1 (Strongly Agree); 2 (Agree); 3 (Neutral); 4 (Disagree); 5 (Strongly Disagree)

	Statement	1	2	3	4	5
1	Collaborative Learning helped me improve my performance in Rectilinear Propagation of Light.					
2	Group learning aroused and sustained my interest in Rectilinear Propagation of Light.					
3	I was motivated to learn when Collaborative Learning Approaches were used in teaching Rectilinear Propagation of Light.					
4	Collaborative Learning Approaches made me understood Rectilinear Propagation better.					
5	I collaborated with other students during group discussions.					
6	I was actively engaged during group instructional lessons.					
7	Collaborative Learning catered for my learning styles in class.					

8	When I work with other students I Achieve more than when I work alone.					
9	Collaborative learning enhances class participation.					
10	Creativity is facilitated in the group setting.					
11	Group activities make the learning experience easier.					
12	I prefer individual learning (non-grouped learning) than grouped (Collaborative Learning).					
13	I learned to work with students who are different from me.					
14	I prefer that my teachers use more group learning activities / assignments.					
15	I eagerly look forward in anticipation to the next lesson because of Collaborative Learning.					