

**STUDENTS' AND TEACHERS' PERCEPTIONS OF PHYSICS PRACTICAL
WORK IN SECONDARY SCHOOLS IN KAKAMEGA EAST SUB-COUNTY,
KENYA**

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SCIENCE IN SCIENCE EDUCATION OF MASINDE MULIRO UNIVERSITY
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DECLARATION

The thesis is my original work prepared with no other than the indicated sources and has not been presented elsewhere for Degree or any other award.

Sign..... Date

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CERTIFICATION BY SUPERVISORS

The undersigned certify that they have read and hereby recommend for acceptance of Masinde Muliro University of Science and Technology, a thesis titled ‘ ‘Students and teachers perceptions of physics practical work in the secondary schools in Kakamega East Sub county.

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DEDICATION

This thesis is dedicated to my late father John Arikana Masinga, my mother Loice Khasandi Masingu, My wife Georgina Amimo and my beloved children; Julius, Kelvin, Eins, Curie, Coulson, Bernice, Arden, Naomi and Leibniz for their support and prayers during the study

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ABSTRACT

In the last ten years, The Kenya National Examinations Council (KNEC) has reported unsatisfactory performance in the physics practical paper 232/3 despite the enthusiasm for practical work among the teachers of physics. In its recent annual report (KNEC 2011), The National mean scores in physics practical paper for the years 2007, 2008, 2009, 2010 and 2011 were 25.85, 23.92, 22.37, 22.24 and 15.22 respectively. The figures listed above are a clear indication that practical work in physics is not yielding the much anticipated results. It is in view of this observation that the present study was initiated in Kakamega East Sub-County to establish the reasons for the current trends in the use of practical work in the teaching and learning of physics. The purpose of this study was to assemble, organize, scrutinize, analyze and interpret the students and teachers perceptions of physics practical work. In this Study, a sample of one hundred (100) students and twenty (20) teachers of physics drawn from fifteen (15) public secondary schools by simple random methods were used. In this study the researcher adopted a purposive survey design to enable him gather information on the students and teachers perceptions of physics practical work because survey produces large amounts of empirical data based on real world observation in a short time for fairly low cost. A questionnaire was used to collect the raw data for this Study. A pilot study for this study was conducted in two public secondary schools to establish the reliability of the research tool. The reliability of the research tool was determined using Miles and Huberman's formulae and found to be 0.77. The information collected in this study was presented by use of frequency tables and analyzed using percentages. The findings of the study indicated that the majority of the students and teachers viewed practical work as a series of investigations that requires good organization and familiarizes students with apparatus and enables them to learn by doing. It is hoped that the findings of this study will go along way in informing teachers of physics and curriculum developers. The finding of this study will be used by curriculum developer to review the current curriculum and make the necessary changes in line with the best practices.

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LIST OF ABBREVIATIONS AND ACRONYMS

ASE	: Association for Science Education
CEMASTE	: Centre of Mathematics, Science and Technology in East Africa.
EASSP	: East African Secondary School Science Project
GDA	: Guided Discovery Approach
H.P.P.	: Harvard Physics Project
K.C.S.E.	: Kenya Certificate of Secondary Education
K.I.C.D.	: Kenya Institute of Curriculum Development.
KNEC	: Kenya National Examination Council
MMUST	: Masinde Muliro University of Science and Technology
MOEST	: Ministry of Education Science and Technology
NSC	: Nuffield Science Course
PSSC	: Physical Science for Non Science Students
PSSC	: Physical Science for Non Science Students
SAPA	: Science A Process Approach
SCORE	: Science Community Representing Education
SMASSE	: Strengthening of Mathematics and Science in Secondary Education
T.S.C.	: Teachers Service Commission
UK	: United Kingdom

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

In this section, the problem and its major sub sections are highlighted. Light is shed on the rationale and trends that necessitated this study. The background information to this study comprising the definitions, general properties and applications of perceptions is provided. The statement of the problem, the purpose of the study, the specific objectives, the specific research questions, the scope and limitation of the study, the assumption of the study and the definitions of terms are covered in this chapter.

The term perception has several meanings depending on the context in which it is used. The Cambridge English Dictionary defines perception as a belief or opinion often held by many people and based on how things seem to be. According to Miriam Webster Encyclopedia the word perception means the way a person thinks about or understands something or someone. According to Oxford English Dictionary perception is the ability to see, hear or become aware of something through the senses of sight, hearing, smell, touch and taste. Different people may have different perception of the same thing. The thinking patterns of living beings differ from one individual to another. According to Reynold (2014) the way a person perceived is influenced by factors such as culture, values, beliefs, myths, attitudes, education, laws and rules in a particular community.

According to Vermon (1955), perceptions are influenced by factors such as expectations emotion, motivation, history and culture.

Similarly Allport (1955) views bodily needs rewards, punishments, emotional consideration individual values, personality as among the factors that influence public perception.

According to Ford (1973) the term perception refers to a level of motor skill learning at which the learner becomes aware of something through the senses of sight, hearing, taste, smell and touch. At this level, the learner touches, hears, smells, tastes and sees.

According to Gestalt (1973) perceptions are illusions. An illusion is something that deceives and misleads. Perceptions are organized and meaningful experiences that have configurations and patterns of their own. They are based on incomplete and unverified information. They can also be controlled by external factors and are directly related to the individual's attitudes, beliefs experiences and knowledge. They are usually considered to be distorted reality.

According to the New Standard Encyclopedia (1966) perception are associated with mammals, birds and reptiles that have highly developed nervous systems.

Until recently most researches into perceptions of students and teachers have been studied in the USA and Europe. This was mainly because these parts of the world possess long established universities and research organization. However there is now an increasing interest in the study of teachers and students' perceptions of physics practical work in Asia and Africa.

Recent studies show that many students perceive physics as difficult, abstract and theoretical (House of Lords, 2006). The subject is considered devoid of applications in the day to day life. Many students find the subject boring, un-enjoyable (Hirschfeld, 2012). Interest in high school physics is decreasing, learning motivation

is declining, and the examination results are getting worse (Garwin & Ramsier, 2003; Manogue & Krane, 2003). In many school settings, little time is allotted for the discipline compared to language and mathematics, the other important subjects (Tesfaye & White, 2012; UNESCO, 2010).

Training in handling physics practical lessons has been ineffective in many developing countries including Kenya. Training in conducting school type science experiments is completely ignored in many university teacher training curricula. Many, if not all the Kenyan university trained Bachelor of Education (Science) graduates lack the skills of handling high school type practical work. There are no school-type laboratories set aside for this exercise in the various Kenyan universities that train teachers (Masingila & Gathumbi, 2012). Being a science subject, effectiveness of teaching physics should be judged by the kind of practical activities that teachers and students engage in (Oyoo, 2004). The consequence is that the physics teachers lack the skills for effectively guiding learners in conducting laboratory work. The attendant advantages of performing practical work are lost on the learners. Practical work may be considered as engaging the learner in observing or manipulating real or virtual objects and materials (Millar, 2004). Appropriate practical work enhances pupils experience, understanding, skills and enjoyment of science.

Practical work enables the students to think and act in a scientific manner thus scientific method is emphasized. Practical work induces scientific perceptions, develops problem solving skills and improves conceptual understanding (Tamir, 1991). Practical work in physics helps develop familiarity with apparatus, instruments and equipment. Manipulative skills are acquired by the learners. Expertise is developed for reading all manner of scales. The observations made and results

obtained are used to gain understanding of physics concepts. Science process skills, necessary for the world of work are systematically developed (Manjit et al, 2003).

In the last ten years, The Kenya National Examinations Council (KNEC) has reported unsatisfactory performance in the physics Practical paper 232/3, despite all the effort made by SMASSE, CEMASTEAM and KICD to improve the teaching of mathematics and science in the Kenyan secondary schools. In one of its reports [KNEC 2011], the National mean scores in physics practical paper 232/3 for the years 2007, 2008, 2009, 2010, and 2011 were 25.85, 23.92, 22.37, 22.24 and 15.22 respectively. The scores listed clearly indicate a dismal performance in the psychomotor domain. It is this observation that prompted this study.

In Kenya, few students choose to pursue the subject "Physics" during the last two years of secondary school (Oriahi et al, 2010; Wambugu & Changeiywo, 2008). Teaching is geared around memorization of basic concepts and their reproduction in the examinations (Sadiq, 2003). The students who enroll for the subject resort to cramming definitions and formulae. Consequently it is difficult for even the high achievers to apply what they have learnt in novel situations. Usually the performance in physics is among the worst among all the subjects at the school leaving level (KNEC, 2003, 2006). The problem of low enrollment and poor performance is particularly noticeable amongst the girls in Kenyan secondary schools (Amunga et al, 2011a; Wasanga, 2009). It locks the girls out from participating in careers that are physics based. The girls form a significant composition of all secondary school going students. This trend of opting out of physics influenced technology is worrying given Kenya's emphasis on the achievement of Vision 2030 (Amunga *et al.*, 2011b). Strategically, the demand for physics should be growing due to its strong influence on

technology programs at university and other tertiary institutions of learning. The low enrollment in upper secondary school physics has been linked to a shortage of inspirational and well trained physics teachers, inadequate laboratory facilities and the accompanying limited exposure to practical instruction at junior secondary school level (Daramola, 1987).

The science teachers are mainly trained in theoretical content aspects. Although practical work in physics is vital to good science teaching its potential has not been fully exploited by the science teachers in Kenyan secondary schools. The study was intended to collect and analyze perceptions of the students' and teachers' perceptions of physics practical work in secondary schools of Kakamega East Sub-county, Kenya so as to devise effective strategies for organizing and teaching practical work in physics.

1.3 Statement of the problem

Whereas practical paper is central to good performance, the Kenya National Examinational Council Report of 2011 shows that the performance of students in physics practical paper 232/3 has been unsatisfactory. The report shows that the learners have continued performing poorly in paper 232/3 country wide in comparison to paper 232/1 and 232/2. The national mean scores in physics practical paper for the years 2007, 2008, 2009, 2010 and 2011 were recorded as 25.85, 23.92, 22.37, 22.24 and 15.22 respectively. The scores indicate that practical work in physics is not yielding the results. It's against this background that this study was conducted in order to investigate the students and teachers perceptions of the importance and challenges of physics practical work.

Physics is a subject of strategic importance within the school curriculum. It opens doors for training in many prestigious careers and professions. The subject helps organize students thinking. It injects order and logic to many problem solving situations. In many cases it is considered the queen of all the sciences.

In the school cycle it is eventually examined is a two theoretical papers and one practical paper. Of these, the practical paper is central to good performance. Good performance will usually translate to good overall physics achievement. Yet secondary school learning and teaching give scant attention to practical work in the subject. Most of the time practical work is done in a dull and unimaginative meant.

This study refocuses attention to the practitioners' perceptions of what doing practical work is concerned. The study focuses on learners and teachers views on what doing physics practical work entails.

1.4 The overall objective of the study

The overall objective of this study was to investigate students' and teachers perceptions of physics practical work in secondary schools in Kakamega East Sub – County, Kakamega County, Kenya.

1.5 Specific Objectives of the Study

The following specific objectives guided the study;

- i. To determine the students' and teacher perceptions of the importance of practical work in secondary school physics.
- ii. To find out the students and teachers' perceptions of the challenges of practical work in physics among secondary schools.

1.6 Research Questions of the Study

The study sought to answer the following questions;-

- i. What are the students' and teachers perceptions of the importance of practical work in secondary school physics?
- ii. What are the students and teachers' perceptions of the challenges of practical work in physics?

1.7 The Significance of the Study

Several aspects make this study significant. It is hoped that this study will shed light on the perceptions of both teachers and students on the nature and purpose of practical work. Secondly the findings of this research may help curriculum developers have insights on whether to lay emphasis on increasing amount of practical work on the subject by instructing schools to purchase more equipment for practical activities in the subject.

Lastly, in accordance with the vision 2030, the technological ideas will be put into use in nation building. The recommendations of this research will be used to improve science aspects in the teaching of physics. Thus the study will ensure more effective studying of physics when the country needs more scientists to advance technology.

1.8 The Scope of the Study

Given the enormous number of schools in Kenya, it was difficult to find the time and resources to cover the whole nation. The study therefore involved one hundred (100) form three (3) students taking physics and twenty (20) teachers of physics selected from fifteen (15) public secondary schools in Kakamega East Sub-County.

The generalizations of the findings of this study are therefore limited to Kakamega East Sub-County and were based on theoretical statements of the students and teachers that took part in the study.

1.9 Limitations of the Study

Several limitations should be considered when interpreting the results of the study. First, the questionnaire developed for this study covered the meaning, requirements, reasons, benefits, importance, impact and challenges of physics practical work only.

Secondly, the methodology of the study, focused prominently on the responses of students and teachers to the items in the questionnaire. Thirdly, the study did not observe a practical lesson within the schools and lastly the study was limited to Kakamega East Sub-county.

1.10 The Assumptions of the Study.

This study was based on three assumptions: Firstly the study assumed that the students involved in the study had positive attitude and interest in physics, secondly the study assumed that the teachers involved in the study had sufficient knowledge on the teaching of physics. Thirdly, the study assumed that the students and Teachers involved in the study gave their honest opinions.

1.11 The Theoretical Framework of the Study

According to the Online Encarto World English Dictionary a framework is a set of ideas, principles, agreements or rules that provide the basis or outline for something that is more fully developed at a later stage.

A framework provides a structure for conceptualizing and designing research studies. It allows us to transcend common sense and make sense of data collected in a study and enables deeper understanding of the study.

This study was guided by the top-down constructivist theory of perception proposed by Gregory (1970). According to Gregory, experiences are important in the interpretation of sensory data. He argues that we perceive using our experiences.

One of the main features of Gregory, they is the fact that it is able to clarify the reasons of our errors and incurrance's quite well. Gregory found a mechanism for explaining illusions and reasons why our perception are so complex and holistic. The theory takes into account our history. According to Gregory, to preserve is to integrate feelings with a broader collect of our beliefs and opinion. Despite having quite different histories, motivations, expectations and emotional states, our perceptions are nearly identical. According to Gregory perceptions allow behavior to be generally appropriate can be ambiguous and are likely to be mistaken for likely issues.

In many countries, practical work has found a central place in the teaching and learning of physics in secondary schools and universities. It is assumed that practical experiences can make physics more real and illustrate the way physicist work in order to gain answers and offer insights into the physical world. (Miller, 2004) emphasis the important role of practical work in helping students to make links between the domain of objects and of observable properties and events and the domain of ideas. However laboratories are expensive in terms of resources and working time.

According to Sneddon, Ahmadi and Raid, 2009, the decline in resource in universities threaten to reduce the extent of experimental work in physics courses in the future.

1.12 Conceptual framework of the study

The conceptual framework of a study is a narrative, mind map, flow chart or diagram showing the key factor, concepts or variables that influence the study. This study considered the students and teachers perceptions of physics practical work, the importance, the challenges, the resources and parental support as shown in the figure 1.1.

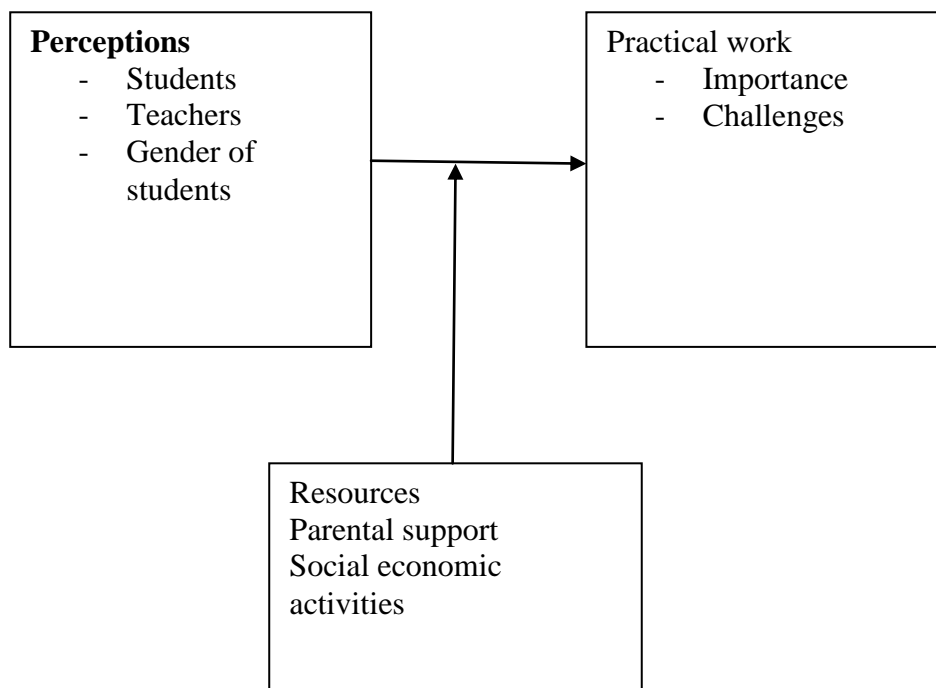


Figure 1.1; Conceptual framework of the study

1:13 Definitions of terms used in the Study

Active learning	The kind of learning where students do more than simply listening to the teachers (Douglas & Jaguit (2009).
Constructivism	A teaching philosophy based on the understanding that learning is as a result of mental construction after reflection on personal experiences and relations (Driscott, 1994)
Gender	Socially constructed differences between men and women.
Life Style	The manners of living which reflect day-by-day one's attitudes and values.
perceptions	Beliefs or opinions often held by many people and based on how things seem to be.
Practical work	Any science activity in which students observe and handle the materials they are studying (Stoffed (2005)
Questionnaire	A data collecting tool used to gather information on knowledge, attitudes, opinion, facts feelings expectations, past experiences emotions etc.
Tacit knowledge	Knowledge that plays an important role in practical intelligence.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The purpose of this chapter is to provide the reader from reading with background information on the meaning, requirements of, reasons for, functions of, the significant of, the impact of, the weakness of, and the barriers to effective physics practical work.

2.2 The Concept of Practical Work

The term Practical work has over the years had a variety of meanings mainly of which were frequently used with little clarifications.

According to Hodson (1990) Practical work is a series of task in which student observe and manipulate real object or materials for themselves. In a study conducted in Ethiopia by Bakalo and Willford (2000) Practical work was defined as laboratory works involving relatively sophisticated and imported expensive apparatus. This definition is reported to have come from the Ethiopia Science teachers. According to Woolnough and Allsops (1985) Practical work can be categorized as exercises, investigations and experiences.

According to Mellor and Tebergien (1999) the term practical work is used in Physics to refer to laboratory activities that include lectures, group experiments and teacher demonstrations where learners are involved in handling and observing real object and materials. Generally Practical work in this case is perceived to be any science teaching and learning activity in which the students working individually or in small groups handle or observe the object and materials they are studying. According to

Lunnetta (2007) in his most recent published review of the literature on teaching and learning in school science, defines practical work as learning experience in which students interact with materials and secondary sources of data to observe and understand the natural world.

According to the report from the Science Community Research Education availed in 2009, practical work was defined as a hands-on learning experience which prompts thinking about the world in which we live.

A SMASSE inset workshop organization in 1999 and hosted by Kakamega High School pointed out that time is an important resource in the organization of practical work and generation of good Practical results.

According to Twoli (2006) a good Practical activity requires concise statements of the objectives to guide the students' focus, explain the procedures for guiding the acquisition of objectives, schematic illustration of apparatus, set up itemized list of materials, data entry facilities usually given in tabular form and report discussion and interpretation of the findings. According to Boz and Boz (2008) a teacher of physics should be equipped with adequate subject matter and knowledge to be able to teach any discipline. According to Van Vestopp (1998) such knowledge is a precondition for teachers to be able to understand the learner's difficulties.

According to Shullman and Tanur (1973) the reasons for doing practical work include arousing and maintaining interest attitude and curiosity in science development of creative thinking and ability to solve problem, promoting aspects of scientific thinking and the scientific methods like formulating hypotheses and making assumptions. In addition, practical work helps to develop conceptual understanding and intellectual

ability and finally to develop practical abilities such as designing and executing investigations, observations, recording data and analyzing and interpreting results.

According to Anderson (1976), the reasons for doing practical work is to foster knowledge of the human enterprise of science and enhance student intellectual and aesthetic understandings to foster science enquiry skills that can be transferred by other spheres of problem solving, to help students appreciate and in part emulate the role of scientist and finally to help student grow both in appreciation of the orderliness of scientific knowledge and the tentative nature of scientific theories and models. In the Ministry of Education Science and Technology curriculum released in 1973 the reasons for doing practical work in physics are to encourage careful observation and accurate recording; to develop various manipulative skills; to arouse and maintain interest and an attitude of curiosity, to show what is meant by scientific experimentation, the proper use of control and the presentation of data verify scientific facts and principles already taught.

According to Hodson (1980) the teachers reasons for administering Practical work are to motivate students by stimulating interest and enjoyment to teach laboratory skills to enhance the learning of scientific knowledge, to give insight into scientific method and develop expertise in using it and to develop certain scientific attitudes such as open mindedness, objectivity and willingness to suspend judgment.

In another report by Simon Mock and Johnson (2000) three reasons for doing practical work are for rewarding students for good behavior, to allow students work at their own pace and to add variety to classroom activities.

According to Kerr (1963) the functions of Practical work in physics are to encourage accurate observation and careful recording to promote simple common sense, scientific methods of thought, to develop manipulative skills, to guide training in problem solving, to fit the requirement of Practical Examinations, to elucidate theoretical work and comprehension, to verify facts and principles already taught.

According to Squirres (1968) Practical work serves to demonstrate theoretical ideas, provide familiarity with apparatus and promotes training on how to do experiments.

According to 8-4-4 physics syllabus (1985) practical work enables students acquire knowledge and skills in solving problems and enable them think critically.

According to Hodson (1990) the functions of practical work in physics are to motivate students by stimulating interests and enjoyment, to teach laboratory skills, to enhance the learning of scientific knowledge, to give insight into scientific method and develop expertise in using it to develop scientific attitudes such as open-mindedness and objectivity.

According to Wellington (1994) the functions of practical work include arousing and maintaining interest in the subject, encouraging accurate observation and careful recording. According to Gott and Duggan (1995) the functions of practical work are to verify theory and illustrate concepts. According to Benatte (2005) the functions of Practical work in physics include, encouraging accurate observations, to make scientific phenomena more real, to enhance understanding of scientific ideas, to arouse and maintain interest particularly in young students and to promote a scientific method of thinking

According to Tamirand (1981) and Woolnough (1991) the significance of practical work is that it helps the students develop their investigatory skills through their results of experimentation.

According to Gott and Duggan (1995:131) the significance of Practical work in the teaching of physics is the development of procedural and substantive understanding and it's enabling of the students to learn by doing and providing opportunities for significant learning.

According to Bemombe (2008) Practical work is significant in the development of thinking skills and problem solving.

According to Scarlon (2002) practical work cultivates conceptual and procedural understanding.

According to Millar (2014) effective Practical work enables students to build a bridge between what they can see and handle and scientific ideas that account for their observations. Allowing time for students to use the ideas associated with observed phenomena rather than seeing the phenomena as an end in themselves is vital if students are to make careful links. Currently the Association for Science Education is leading a new programme of professional development called "Getting Practical". This programme is designed to support teachers, technicians and teaching assistants in improving the effectiveness of Practical work through tailoring and managing practical activities to meet particular aims.

According to Woolnough and Allsops (1980) practical work in the majority of schools is closed, convergent and dull. The students find it being boring and discouraging.

According to Kasanda (2008) most physics teachers lack content. This makes it very difficult for them to excite the students. Similarly Benfaulin (1997) observe that many science teachers possess insufficient subject matter which renders the teaching deficient.

Finally there are barriers to effective practical work that have been identified by scientist. According to Cook and Taylor (1994) lack of teacher knowledge skills and confidence restrict the amount of practical work that can be performed. According to Thair (1999) lack of laboratory assistants and long period of preparing for lessons are a barrier to effective practical work. According to Kobala and Tippens (2000) overloaded Science teachers have no time to prepare and supervise practical activities. This matters teaches to focus more on completing the syllabus on preparation for national Examinations. According to Banu (2011), the factors hindering teaching and learning Practical work include:- Lack of sufficient equipment to do practical work, lack of practical equipment for classroom teaching, poor quality of equipment, the length of time for practical classes, lack of laboratories, heavy teaching loads, irregular attendance of classes by students and an overloaded curriculum.

2.3 The Students Perceptions of Physics Practical Work

There have been many studies that have looked into students' perceptions towards science (such as Barmby et al., 2008; Bennett & Hogarth, 2009; Cerini et al., 2003; Cleaves, 2005; Osborne et al., 2003), and how they perceive science in comparison to other issues and subjects. Yet, in reviewing the literature surrounding students' perceptions on the nature and purpose of practical work, what is reflected is how there is no research specifically, into what, and why, students think and feel about practical work as well as whether practical work has an affective value in influencing students'

decision to continue with science post compulsion. It appears that practical work is seen as motivating by teachers, as shown through the vast amount of empirical data Holstermann, et al (2009). However, there is a need to ask students direct questions regarding their affection to practical work, such as “do they enjoy practical work? Does it motivate them?” (Wellington, 2005, p. 101)

Before the twentieth-first century, the few studies that mentioned students’ perceptions on practical work seemed to show that whilst claiming to enjoy it, students saw it above all as a means of confirming scientific theory and as a teaching method used to prevent them from being bored (Such as Denny & Chennell, 1986). Driver et al. (1994) found that the majority of students did not know “the purpose of practical activity, thinking that they ‘do experiments’ in school to see if something works, rather than to reflect on how a theory can explain observations” (p. 6). Indeed, according to Watson and Wood-Robinson (1998), there is a disagreement between what students and what teachers understand are the aims of practical work. This in turn meant that students would rarely take advantage of any effective or affective value that it could have on their learning of science, with cognitive engagement being rare (Watson, 1994). In contrast, Hart et al., (2000) discovered that students “made strong links between the teacher's intentions and the tasks they were given and this had an impact on students' thinking about the practice of science” (p. 672).

By 2000, Hart et al. (2009) found that students around Key Stage 4 were at the age where social communication was of high importance, so students would enjoy the chance to interact during practical work. Yet, as has been explained by Bennett (2005) this interaction may have been far from the chance to discuss the science of the practical work but instead to interact about their social life. Hart et al., (2000) also

found that for the majority of students, “acting out the role of the scientists helped them derive a better understanding than merely reading or talking about it” (p. 671). However, Hart et al. (2000) are unclear whether students’ had better understanding of the scientific concepts or of the role of a scientist in the practical work they were undertaking. Hart et al., (2000) also found that for effective engagement by students with the practical work they needed to bring some prior knowledge of the scientific concepts to the practical work.

Students need to possess a personal interest in practical work to engage fully in the process of learning science. As Bergin (1999) explains, if a student has a low personal interest they might enjoy the embellishments of learning in this case practical work but not master the course content unlike those students who have a strong personal interest who may even become annoyed by such embellishments because they do not require the same stimulation in order to be attracted to the scientific content. Indeed, Hodson (1998) explains that students who are aware of their ability have stronger control and confidence in their learning. Therefore, those students that have a personal interest and are academically able may ironically be irritated with practical work, especially so if their laboratory skills are of a high ability also, as laboratory skills are necessary for students to engage effectively in practical work (Hodson, 1998). The House of Commons (2002) report explained the concern that practical work: is frequently uninteresting and demotivating. As a result, many students lose any feelings of enthusiasm that they once had for science. All too often they study science because they have to but neither enjoy nor engage with the subject. And they develop a negative image of science which may last for life.

However, according to the JCQ (2009) science numbers have actually increased in recent years with biology ranking third most popular General Certificate of Education Advanced Subsidiary level, with 6.55% of the total number of students in England studying the subject and chemistry ranked eighth. Physics had shown an increase in student numbers, but was only ranked ninth, with a 4.77 percent change from 2008 to 2009 (JCQ, 2009). What appears from the data is that the recent uptake in biology seems far more prominent than in physics and chemistry. Indeed, chemistry and physics are the two subjects that have been argued to contain the most practical work throughout Year 7 to Year 11 in schools (Abrahams, 2009).

The House of Commons (2002) reported that students perceived practical work as a helpful way of linking theory and practical knowledge as well as providing the manipulative skills. Such aims are similar to those that Abrahams and Millar (2008) explain effective practical work can achieve. In reality of course, the report observed that not all students enjoyed, or were motivated by, practical work, some students commented that a better range of practical work approaches was needed, helping students to experiment and investigate more (House of Commons, 2002). In addition, students found a problem in achieving the desired result and for some there was disaffection in carrying out practical work that was merely in a recipe style or where they already knew the result. The House of Commons (2002) explain how students view practical work rather negatively but suggested that students should have a variety of exciting opportunities to experiment and investigate. Regardless of the apparent flaws noted by the students themselves at the time, it appeared that practical work was still seen as a major affective part of science by teachers. Osborne et al., (2003) found that 71 percent of students who stopped studying science still valued it

as interesting and more importantly 79 percent saw it as interesting. This could possibly be suggesting the link between practical work and enjoyment in school science but not the link to student retention post compulsion. These findings support the claim made by Abrahams (2009) that practical work may generate enjoyment for individual science lessons but is rather ineffective at prolonging this motivation to study science post compulsion or influence a personal interest in it even though it is often thought to be the case.

Cleaves (2005) analyzed transcripts from four inter-perceptions that were conducted over a three year period involving seventy-two secondary school students of high academic ability. Though Cleaves' study was looking into students general formation of post-16 choices and did not focus primarily on their perceptions about practical work (a problem with the majority of research studies into such areas), Cleaves discovered that students thought that they carried out less practical work in Year 11 and comments, such as the following example were made:

I don't enjoy science very much here. Not all teachers can hold our attention. The practical is pedantic. We know that to get high marks you have to put in a lot of detail, but we are not experimenting anywhere near the level of the write-up Cleaves (2005).

It is important to note that in Cleaves (2005) the students, from six mixed comprehensive schools in England, were well above average in their academic ability across all subjects, including science. As the students were of high academic ability in science, there is the possibility that this factor alone could, as Cleaves (2005) suggests, influence them to continue with science post compulsion. Indeed, Cleaves (2005) notes that despite their somewhat negative comments, the student quoted above still opted to study science post compulsion. There have been suggestions of

the many factors that influence students decisions to continue with science subjects, such as: future career or university aspirations (House of Commons, 2002b), the value students and parents place on the relevance of the subject to the students' life (Jenkins & Pell, 2006) and, the traits of the individual teacher, and other members of staff, that impact on students' learning of science (Jarvis & Pell, 2005; Reiss 2005). Cleaves (2005) also found that whilst many students claimed to enjoy practical work, there was widespread criticism that there was less time devoted to conducting practical work in science lessons as they progressed through the schooling system.

It therefore seems that even though students wish to conduct more practical work, possibly because they enjoy it over other methods of learning science, they do not feel that what is taught in their classes is the best that it could be. Moreover, this is an influential finding considering the nature of the students involved were higher ability students, because despite their concerns about practical work some of them are still opting to study science post compulsion. The implications of the use of practical work on lower ability and disaffected students in science may influence them to hold a slightly less negative image of science (Abrahams, 2009).

More recently, Barmby et al., (2008) have reported students' perceptions towards practical work decrease from Year 7 to Year 9, but only slightly. Nevertheless, the decrease did mean that the study found students to perceive school science as boring because practical work was essential to them for enjoyable science and they conducted little. Yet, it appears that students only preferred practical work to other means of learning science; as one student commented "I like science when you do practical's rather than when you're writing stuff" (Barmby et al., 2008, p. 1088), such findings were similar to a more recent study by Abrahams (2009). As the paper by

Barmby et al., (2008) was primarily based on students' perceptions to science and the perceived decline in their perceptions to science, it did not question the students, either about practical work or what they meant by 'boring'. Furthermore, the method of data collection involved the students ranking each of the perceptions measures on a five-mark scale (5 = strongly agree, 4 = agree, 3 = neither agree nor disagree, 2 = disagree and 1 = strongly disagree) and so a more detailed evaluation of students' opinions could only be ascertained from the 4 percent of students subsequently interviewed. Furthermore, there is a need for caution when using such Likert scales and the need to be aware of the many limitations that their use entails because they do not express the overarching picture of students' perceptions of practical work in this case (Cohen, et al 2007).

It is clear from the research that the majority of comments regarding students' perceptions towards practical work are generally found as a by-product of researching other areas of students' perceptions towards science or decision making post-compulsion (such as Barmby et al., 2008; Cleaves, 2005). As Wellington (2005) has suggested there is a need to question students more candidly if we are to fully understand the reasons why they claim to be motivated by, and enjoy doing, practical work and yet so many of them chose to not pursue the study of science post compulsion.

According to Renner (1995) the majority of students expressed highly positive feelings towards practical work in school physics. The students thought that practical work is important to their developing of understanding of concept being taught.

According to Dewny and Chennel (1986) Practical works reduced boredom. The students therefore see practical work as an enjoyment activity; one that relieves the

boredom of a lesser and improves the mastery of new concepts. According to Watt (1988) most students complained that Practical work lacked coherence or continuity and may be expressed less than ideal science teaching. In that connection the students preferred laboratory activities help the students to remember, are less confusing and more concrete than other and that makes students think about the phenomena they are observing. According to Tobin (1986) teachers preserve practical work as an effective way to learn science. Accordingly lower ability students tended to lose think of experiments create equipment and disregard safety procedures.

2.4 The Teachers Perceptions of Physics Practical Work

Some educational researchers have noticed that teachers are surprised when asked to consider the purpose of practical work in school science (Such as Donnelly, 1995 and Wellington, 1998). It appears that practical work has become a typical component of science education within English schools. So much so that teachers see no reason to question why they do what they do with practical work. Indeed, according to Gott and Duggan (1995) teachers were “confused as to the role and purpose” (p. 63) concerning the investigations that had become part of the Science National Curriculum. Perhaps the fact teachers are not thinking about the reasons for the implementation of practical work would explain for the appeared confusion. Such an issue also places uncertainty on the reliability of their perceptions within studies relating to perceptions of the purpose of practical work. Certainly, Parkinson (2004, p. 185) justifies a variety of factors from personal to societal issues (relating mainly within their respective schools) for how teachers’ perceptions of practical work are formed.

A study by Swain et al. (1999), reported the “perceptions to the aims of practical work given by science teachers from Egypt, Korea and the UK” involving 66 UK science teachers from 58 secondary schools (p. 1311). The study involved teachers ranking each of the twenty aims, which came from the studies by Beatty and Woolnough (1982) and Kerr (1963), on a four point scale (1 being least important and 4 being most important).

The study found the UK teachers to respond with the perceptions of practical work as, being a way for students to work through an investigative process: “the seeing and solving of problems, critical perceptions and logical reasoning... [emphasizing]... the manufacture of new knowledge rather than the rehearsal of existing knowledge” (Swain et al., 1999, p.1315). However, all science teachers from all three countries acknowledge within the top ten aims that “to arouse and maintain interest” (ibid, p. 1318) was a component of practical work but rated the scientific skills acquired from doing practical work higher: “Empirical work is the defining feature of science” (ibid, p. 1317). Yet all UK teachers explained that the implementation of practical work was essential in benefiting students in their understanding of scientific concepts. This is not surprising considering the amount of practical work being conducted at this time and the assessment of student practical work constituting “about 20% of the terminal examination mark” at General Certificate of Secondary Education (GCSE) level (Black, 1995, p. 163).

In conclusion, the analysis by Swain et al., (1999) demonstrated the problem of collecting attitudinal data at a specific moment in time from a range of different settings and where the approach to school practical work also differed - not primarily due to the variance between countries. Incidentally, these differences along with the

specificity of time may have influenced teachers' decisions regarding the aims of practical work and ultimately their general perceptions to it: "different opinions on the aims of practical work arising from different national, educational and social contexts at one point in time and these may change because of societal pressures (Swain et al., 1999, p. 1322, italics added).

A further study by Donnelly (1998) involved inter-perceptions with secondary science teachers from five schools with forty inter-perceptions being analysed. The results found: Subjectively, it seems that science teachers experience not the laboratory but its absence as a constraint. And, while it might be said that access to a laboratory provides science teachers with greater flexibility, it appears that both materially (in what the laboratory encourages and what it resists), and pedagogically (through the ways teachers construe laboratory work against other forms of activity), such flexibility is often experienced as a tension between negative and positive alternatives.

It seems to imply that teachers were in a situation where the pedagogy of practical work was difficult to portray in a positive manner, meaning that not all aims were effectively achieved at once. As Wellington (2002) suggests, teaching one form of practical work continually will not be successful or effective in learning. There is always a need for the teacher to accommodate for the need of the learning outcome, so it is important to apply the form of practical work that links to the learning outcome. An analogy to Wittgenstein's (2001) understanding of a game is useful in understanding the importance of linking the practical work to the learning outcome. According to Wittgenstein (2001), it would be possible to explain what is meant by a 'game' and to describe the general themes but it would be harder to describe the rules. This is because each specific game includes specific, individual rules: there are no

generic rules for all games. Similarly, it is possible to describe practical work but would be harder to ascertain a single format of practical work suitable for all learning outcomes. Indeed, as each type of practical work is unique, teachers have a range of purposes, or learning objectives to meet in science. Therefore how teachers approach each purpose will determine the type of practical work they indeed do conduct. However, at times teachers explain there is a need, especially at Open Evenings, to present “eye catching and exciting” practical experiments with the aim of attracting students to the image of science as a “hands-on fun activity” (Abrahams, 2007).

The more recent study by Abrahams and Saglem (2010) which compared current teachers’ perceptions with those teachers in the twentieth century in the study by Kerr (1963), found that, regardless of the changes within the last 46 years, teachers’ perceptions on the important aims of practical work remained constant. Similar findings were noted in Swain et al., (2000) that found after 35 years teachers had been “fairly consistent in their perceptions to the aim of practical work” Abrahams and Saglem (2010) justify the similarities by explaining that it is merely “a reflection of the fact that there is less perceived competition between the aims” but not across all Key Stages. Bennett (2005) also explains that the aims can be linked and summarised in a variety of ways. Abrahams and Saglem (2010) found that teachers’ perceptions at Key Stage 5 explained how there was a need to “make science real and relevant in order to maintain an interest in what was a much more conceptually demanding subject than it had been at Key Stage 4”.

Though there is uncertainty on such reasoning, it may be necessary for encouraging students to study science post compulsion and thus the aims relating to scientific skills seem rather irrelevant to the teaching of practical work at this level. One teacher in the

study stated “If they don’t know how to do it by the time they’re doing ‘A’ level [Key Stage 5] they shouldn’t be doing ‘A’ level physics”.

This could imply that teachers are keen to engage students to continue with science, yet, it could be argued that at A-level especially, students should personally want to study the subject and not require motivation from the teacher that seemingly is needed at Key Stage 4, (Abrahams, 2009). Unlike the study by Swain et al. (1999), Abrahams and Saglem (2010) did not find changes in educational and societal settings constituting for the changes in teachers’ perceptions. Instead, Abrahams and Saglem (2010) found that “changes in the working environment have the potential to lead to changes in pedagogy if those changes generate pressure on (or removed it from) teachers” (p. 13, italics in original).

According to Yung (2006), teachers’ perceptions on practical work differ according to their opinion of “fairness” within education. The findings showed that “teachers holding perceptions of fairness in the context of providing students with an all-round education and/or providing students with the chance to learn the subject matter” were inclined to view practical work as a means of “developing students’ affective / cognitive/ motor skills” (p. 216). Yet, teachers appear drawn between two perceptions of practical work- motivating students and providing the skills for continuation in science and meeting the needs of the practical examinations (House of Commons, 2002). Although the key to better practical work, in meeting the effective and affective claims, does not come solely from “doing more practical work, but of doing better practical work” (Millar & Abrahams, 2009).

It appears that the research carried out into teachers’ perceptions of practical work have primarily focused on teachers arranging aims in rank order of importance. There

seems to be little investigation into why they believe such an aim is of such an importance or what they actually do within their practical sessions concerning the affective domain.

Studies, such as the above, have found teachers commenting on practical work as motivating, exciting and attractive to students alongside viewing it as useful in improving their skills of observation and developing conceptual understanding.

However, the use of practical work as a means of attracting students in order that they continue studying science post compulsion has potentially limited effect. Indeed, it would appear that teachers are overestimating the actual reality of the motivational and affective value that practical work claims to hold. A comment made by a teacher in Abrahams (2009) summarizes the reality:

In most instances its short-term engagement for that particular lesson rather than general motivation towards science. In general I think it's very difficult to motivate kids in Year 10 and 11 into thinking about engaging in science and thinking about science in terms of 'that's a career that I want to follow'... (p. 2336) this statement is similar to the findings in House of Commons (2002a). Yet, Parkinson (2004) found that teachers' perceptions of practical work were different to those of their students. Indeed, it has been noted that there is a need for teachers to convey the purpose of the practical task to the students to enable them to see and understand what it is that they are expected to achieve. As Driver et al., (1994) suggests, "There is a case for 'letting learners into the secret' of why they are asked to do different types of practical work in school" (p. 6) in the hope that it will aid the learning process. According to Hart, Mulhall, Berry, Loughran, and Gunstone (2000) it appears that there is evidence to suggest failure of learning from practical work is possibly due to teachers "claiming

too much for laboratory work” (p. 672), regarding the effective and affective domain for students, to the point that teachers can seem to miss what realistically can be achieved.

2.5 Female Students’ Perception of Physics Practical Work

According to Whyte (1984) female students view practical work in science as an aid to learning and understanding science concepts and as a memory aid. They view teacher’s demonstrations as an inadequate replacement for hands on practical work. the female students hold the opinion that the students require some theoretical background knowledge before proceeding with practical work if they are to obtain the maximum benefit from the experience and according to the females students prefer to understand a self directed inquiry rather than a prescribed one if they have a familiarity with the material. The preference may change if the work may be graded.

According to Millar (1985) female high school students view practical work in science as an aid to learning and understanding science concepts and as an aid to memory.

Girls, according to Tobin (1988) desire to work in mixed group because they perceive boys as being better than they are in science. The girls require that the methodology of school science education be reviewed to take the interest of girls into account.

According to Mellar and Driver (1987), girls view teacher demonstration as inadequate replacement for hands on practical work. Furthermore, the girls require theoretical background knowledge before proceeding with practical work, if they have to benefit from the experience. Additionally, girls prefer to undertake a self-directed

inquiry rather than a prescribed one, if they have some familiarity with the material. This preference can change if the practical work is to be graded.

However, research findings have showed that girls place high value on practical work. Even among those girls who dropped physics while in form two it was remarkable commented favourably on their attitude to practical work in the older years. According to GIST (1986) girl friendly physics should provide visual and physical first hand experiences which will help students to understand scientific processes. Generally, girls seem to regard practical work as an enjoyable aspect of the science course and recall it many years later.

2.6 Male Students Perception of Physics Practical Work

According to Tobin (1988) boys are more likely to engage in activities which facilitate science learning to a greater extent than girls. Tobin's observation in classroom situations showed that the vast majority of teachers taught using whole class activities. The teachers tended to involve boys and girls to an equal extent when engaged in lower cognitive level interactions, but tended to involve boys to a greater extent than girls in high cognitive interactions. Boys participate in a more overt manner and were involved in responding to questions intended to stimulate thinking to a much greater extent than girls. More boys than girls stated that they liked to answer questions, and teachers elaborated more on boys' responses to questions.

Target students whom the teachers asked questions of most frequently were generally boys. During practical work boys tended to be more involved in handling equipment, an observation that has been reported elsewhere (GIST, 1986) Science Council of Canada). In the Grade 11 classes where the girls had made a deliberate choice to study

science the dominance of boys was less visible. The situation was not entirely the result of boys' and teachers' behavior.

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

3.1. Introduction

The purpose of this study was to explore the perceptions of students, teachers, girls and boys and of physics practical work. To achieve this, the data collected from secondary schools in Kakamega East sub-county was used. This chapter provides information on the methodology employed in this study.

3.2 Research Design

Every research is usually preceded by a plan or blue print of the steps the researcher will follow to conduct the study. In this study, the researcher adopted a survey design to enable him investigate the research problem.

This approach consisted of the identification of the research problem, formulation of the research questions and designing a questionnaire to could answer the research question. The study was then preceded by piloting the research problems on students of Kakamega High School to establish its validity. A letter authorizing the study was obtained from the university administration and the National Council of Science and Technology. The study was conducted on a sample of 52 boys and 48 girls selected from 15 secondary schools in Kakamega East Sub-county obtained by a random sampling process. The corrected and modified questionnaires were then delivered to schools and administered on the sample population the same day. The answered questions were then collected back for analysis. To ensure that the questionnaires were suitable, the researcher incorporated the input of lecturers, colleagues and

individuals of target population. The data collected from the study was analysed, interpreted and discussed. The findings of the study were then recorded to the panel of examiners. The survey design was considered appropriate because it produces data based on the real world observations. Surveys also produce large amounts of data in a short time at a fairly low cost.

3.3 Location of Study

The study was carried out in Kakamega East sub-county in the former western province in Kenya. The headquarters of the county is located at Shinyalu shopping centre that is eight kilometers south east of Kakamega town. The sub-county was chosen because of its poor performance in Physics Practical paper 232/3 over the years.

3.4 The Target Population

This study targeted all the form three students taking physics in Kakamega East Sub-county. The sub-county has forty Six (46) secondary schools of which two (2) are county schools and forty four (44) are Sub-county schools. The list of all secondary schools that took part in the study is presented in appendix C of this document.

The sample population for the study consisted of 100 form three students from 15 public secondary schools in Kakamega East sub-county. The county has 46 secondary schools of which two are extra county schools; six are county schools and 38 sub-county schools. The list of the secondary schools that took part in the study is presented in appendix C of this document.

3.5 The Sampling Procedure

This study employed the simple random sampling method to select 15 secondary schools from a total of forty six (46) secondary schools in Kakamega East Sub-county. A total of one hundred (100) and twenty teachers (20) participated in the study. The number of teachers and students involved in the study were collected and presented in the table below.

Table 3.1 Number of students and teachers involved in the study.

	Females	Males	Total
Students	48	52	100
Teachers	3	17	20
Total	51	69	120

This technique was considered appropriate because it ensures that all the school have equal chances of being included in the study sample.

In this study simple random method was used to select 15 secondary schools from the 46 schools in the county. The process involved writing the names of the 46 schools on small pieces of paper and shuffling them up in a box. Fifteen pieces of paper were picked from the box one at a time without replacement. The names of the fifteen schools picked from the box were recorded as the schools for the study furthermore an average of seven students from each one of the fifteen schools were identified by the purposive sampling method to participate in the study. A total of a hundred students were selected to participate in the study and twenty of their teachers of physic.

3.6 Research Instruments

A closed ended questionnaire was used to collect data in this study. According to Johnson and Christie (2008) a questionnaire is a self-report data collection instrument that each research participant fills as part of the study. The questionnaire in this study was presented to 32 Form 3 students of Kakamega High School to determine its reliability. According to Miles and Huberman (1994) the reliability of the questionnaire was found to be 0.77 using the formula $R = \frac{C}{C+D}$ when R symbol for reliability, C is the symbol for consensus and D is the simple for differences. A questionnaire was selected for this study because it gathers information from people in a wide geographical area. A questionnaire strives to secure information about present practices, conditions and demographic data. Occasionally a questionnaire asks for opinion or knowledge. Questionnaires were more preferable in this study because they were used to obtain information about thoughts, feelings, attitudes, beliefs, values, perceptions and personality behaviour of the participants. Questionnaires are the most frequently used data collection tools in educational and evolutionary research. Questionnaires help gather information on knowledge, attitudes, opinions behavior, facts and other information.

The validity of the information is established using a panel of experts and a filled test.

The purpose of this study was to investigate the perceptions of students and teachers about physic practical work. To be able to achieve this purpose a well designed questionnaire was developed and administered to teachers and students targeted in this study. According to Okoni and Jumbe (1997) there's no single method that can be used to gather sufficient data. However two or more methods can be used to collect data in any study. The questionnaire was designed to tease out interest of the sample,

past experiences, expectation, beliefs, age and personality. These were felt to influence individual sample perceptions.

3.7 Pilot Study

A research tool should be tested on a pilot sample of members of the target population. The process allows the researcher to identify whether respondents understand the questions and instructions and whether the meaning of questions is the same for all respondents. Where closed questionnaires are used piloting highlights whether sufficient response categories are available and whether any questions are systematically missed by respondents. According to Palton (1990) a pilot study is a smaller version of a full scale study. It involves the Pre-listing of a particular research instrument such as a questionnaire. The questionnaire for this study was piloted on 24 students and two teachers not from the study sample. The procedure for conducting the pilot study is the same as the one for the main survey.

3.8 Data Collection Procedures

Before going out in the field to collect data the researcher applied for a permit and a letter of authorization from the national Council of Science and Technology (NACOST) and a letter of introduction from Masinde Muliro University of Science and Technology (MMUST) in order to facilitate the study. In addition to the permit, letter of authorization and letter of introduction the researcher also engaged three research assistants namely:- Einstein Khamadi of Egerton University and Evans Shibachi of Khayega cyber and Caleb Wituka of Visiocomp Enterprises.

The three assistant were useful in collection and maintenance of the confidentiality of the respondent. The performances of the three research assistants were recommendable.

3.9 Data Analysis Techniques

The purpose of this section is to summarize the data, data generated in the study so that it is completely understood and provides answers to the original research questions result This study generated both qualitative and quantitative data.

Ultimately all field work culminated in the analysis and interpretation of some set of data be it quantitative survey data experimented recordings, historical and literary texts qualitative transcripts or discursive data. The process if analyzing data involved breaking up it the data into manageable, themes, patterns, trends and relationships. The aim of analysis was to understand the various constitutive elements of one's data through an inspection of the relationships between concepts constructs or variables and to see whether there are any patterns or trends that can be identified isolated or can be established in the data. Interpretation of the data consisted of formulating theories that can account for observed patterns and trends in the data. Interpretation therefore means relating ones results and findings to existing theoretical frameworks or models, and showing what levels of support the data provide for the preferred interpretation.

After consulting my supervisors, it became necessary to construct a table showing how each research objective was handled as shown in table s below

Table 3.2 Nature of Objective and type of data

Objective	Nature of Objective	Type of data used	Mode of data analysis
1	Designed to provide data to enable determine students participation of physics practical work	Quantitative data	Frequencies and percentages
2	Designed to provide data that would enable us find out the teachers perceptions of physics practical work	Quantitative data	Frequencies and percentages.
3	Designed to investigate the female students perceptions of the importance and challenges of physics practical work	Quantitative data	Frequencies and percentages
4	Designed to investigate the male students perceptions of physics practical work	Quantitative data	Frequencies and percentages

In this study, data collected by qualitative methods was analyzed using the content analysis methods while data collected by quantitative methods was analyzed using frequencies and percentages.

That was analyzed descriptively. In addition qualitative data was also useful in uncovering trends in thought and opinion of the respondents. Quantitative data was used to quantify the problem as a way of generating numerical data. Similarly quantitative data was used to quantify the view, opinions and the perceptions of students' responses.

CHAPTER FOUR

PRESENTATION, INTERPRETATION AND DISCUSSION OF THE FINDINGS

4.1 Introduction

This chapter consists of three sections: Section 4.2 provides information on the characteristics of the respondents in the study. Section 4.3 discusses and presents the students and teachers perceptions of practical work in physics. Section 4.4 presents and compares the perception of the female and male respondents of the practical work in physics.

4.2 Characteristics of the respondents that participated in the study

This section consists of two sub sections:- Sub section 4.2.1 provides information about characteristics of the students who participated in the study while subsection 4.2.2 provides information about the characteristics of the teachers involved in the study.

4.2.1 The characteristics of the students who participated in the study

This study involved 100 (One Hundred) students of Physics of whom (Forty Eight) 48 were female and (Fifty Two) 52 were male. However all the hundred students involved were of the ages between 16 – 21 years? Some of the students were boarders other were day-scholars.

4.2.2 The characteristics of the teachers who participated in the study

The study involved (Twenty) 20 teachers of whom (Seventeen) 17 were male and (Three) 3 were female. Six of the male teachers were over 35 yrs of age and 11 of them were of ages of 22 – 35 yrs. All the female teachers who participated in the study were between 22 – 35 yrs of age. All the 20 teachers were trained teachers with experience.

4.3 The Students Perception of Practical Work in Physics

This section is designed to address the first objective of this study that seeks to determine the student's perceptions of the importance and challenges of practical work in secondary school physics. This section consists of eight sub-sections: 4.3.1. presents, interprets and discusses the students perceptions of the meaning of practical work in Physics. Subsection 4.3.2. Presents, interprets and discusses the student's perception of the requirements of practical work. Subsection 4.3.3. Presents, interprets and discusses the student's perceptions of the reasons for doing practical work. Sub-section 4.3.4. Presents, interprets and discusses the student's perceptions of the functions of practical work. Subsection 4.3.5. Presents, interprets and discusses the student's perceptions of the significance of practical work. Subsection 4.3.6. Presents, interprets and discusses the student's perceptions of the impact of practical work in Physics. Subsection 4.3.7. Presents, interprets and discusses the student's perceptions of the weaknesses of practical work. The last Subsection 4.3.8. Presents, interprets and discusses the perceptions of the students on the barriers to effective practical work in Physics.

4.3.1 The Students Perception of the Meaning of Practical Work in Physics

The study gathered data on perception of students on the meaning of practical work in physics; summary of the data is presented in Table 4.1.

Table 4.1: Students perceptions of the meaning of practical work

Meaning	Students Perceptions		Totals
	Yes-f(%)	No- f(%)	Total
A. Practical work in Physics is a series of exercises	04(04%)	96(96%)	100(100%)
B. Practical work in Physics is a series of investigations	62(62%)	38(38%)	100(100%)
C. Practical work in Physics is a series of experiments	29(29%)	71(71%)	100(100%)
D. Practical work is a series of tasks	05(05%)	95(95%)	100(100%)

As shown in table 4.1 above, 62.0 of the students in the YES category were of the opinion that practical work is a series of investigations, 29% of the student indicated that practical work in physics is a series of experiments, 5% of the students felt that practical work in physics is a series of tasks while 4.0% held the opinion that practical work in Physics is a series of exercises.

Similarly, 96.0% of the students in the NO category strongly disagreed with the statements that practical work in Physics is a series of exercises. 9.5% were convinced that practical work is not a series of tasks, 71.0% did not believe that practical work in

physics is a series of experiments, while 38.0% of those in NO category opposed that the assertion that practical work would be a series of investigations. Indeed many of the students didn't seem to be very clear what the meaning of practical work in Physics is.

However, in a similar study conducted in United Kingdom (2007) by the science community Representing Education (SCORE), it emerged that practical work has a variety of existing definitions many of which one frequently used with little clarification. The study therefore attempted to define practical work as learning experience in which students interact with materials or with secondary sources of data to observe and understand the natural world. In this study the concept of practical work in physics is considered to be any science teaching and learning activities in which students working individually or in small groups handle or observe the object or materials they are studying. Investigations exercises experiments and tasks are all kinds of practical work.

According to Woolnough and Allsops (1985) Practical work can be categorized as exercises, experiences and investigations. According to Hodson (1990) Practical which is a series of tasks in which students observe and manipulate real objects or materials themselves. According to Gott and Duggan (2003) Practical work is the teaching and learning approach that develops procedural understanding as well as substantive understanding. In their view, practical work allows learning by doing and is an important experience of ones own productivity and provides opportunities for significant learning about oneself and the world.

According to Robin Millar (2004) the term practical was perceived as any teaching and learning activity which at same point involves the students in observing or manipulating the objects and materials they are studying.

According to Abel and Leaderman (2007), Practical work is a series of learning experiences in which students interact with materials to observe and understand the natural world. However, many of the students are reported to perceive the meaning of practical to be series of investigations.

4.3.2. The Students perception of the requirements of practical in Physics

In this sub-section, the students' perceptions of the requirement of practical work in Physics were collected and presented in Table 4.2.

Table 4.2: Students perception of the requirements of practical work in physics

Requirements	Students Perceptions		
	Yes-f(%)	No- f(%)	Total
A. Practical work in Physics			
Requires adequate apparatus.	20(20%)	80(80%)	100(100%)
B. Practical work in Physics requires			
Careful preparation before hand .	25(25%)	75(75%)	100(100%)
C. Practical work in Physics requires			
Good organization throughout.	45(45%)	55(55%)	100(100%)
D. Practical work requires well			
trained teachers.	10(10%)	90(90%)	100(100%)

The data presented in table 4.2 above shows that 45.0% of the responses in the YES category were of the opinion that practical work requires good organization throughout. Another 25.0% of the YES responses indicated that practical work in physics requires careful preparation before hand. About 2.0% others believe that practical work in physics requires adequate apparatus while small percentage of 10.0% of the students in YES category were convinced that practical work requires well trained teachers.

In sharp contrast 90.0% of the students in the NO category indicated that practical work does not necessary require well trained teachers. Another 80.0% did not figure out why physics practical would require adequate apparatus. Another 75.0% of the students in YES category did not feel that practical work in Physics requires careful preparations before hand, while a 50.0% of the student responses felt practical work does not necessarily require good organization. However, the finding of the study conducted in United Kingdom (2007), by SCORE it was observed that practical work required adequate apparatus, careful preparation, good organization and trained teachers. This study echoes the finding of a similar study conducted by SCORE (2007).

According to Farrant (1964) practical work requires careful preparation and organization before hand to generate activities that are profitable, motivating and satisfying. In his opinion, all practical tasks are characterized by introduction, presentations and conclusions must be planned in advance.

In the opinion of Boz and Boz (2008) a teacher cannot understand any discipline without adequate subject matter and knowledge. According to Vestop and De Vos (1998) such knowledge is a precondition for our teachers being able to understand student learning difficulties.

According to Twoli (2006) to give practical work requires correct statements of objectives to guide the student's focus, presence of explicit procedures for guiding the acquisition of objectives, schematic illustration of apparatus set up itemized list of materials, data entry facilities, usually given in a tabular form, report, discussion and interpretation of the findings. A SMASSE inset workshop hosted by Kakamega High

School in 1999 the participants pointed out that time as a prime resource in organizing and obtaining practical result.

According to Solomon (1980) any science teaching must take place in the laboratory. Science simply belongs there.

According to Miller and Driver (1989) practical work serves to develop deeper understanding of concepts and purposes of science.

However, the majority of students in this study are reported to perceive good organization as a requirement for good practical work.

4.3.3. The Students perceptions of the reasons for doing practical work in physics

In this sub-section the students perception for the reasons of doing practical work in Physics were collected and recorded in Table 4.3.

Table 4.3: Students perceptions of the reasons for doing practical work in physics

Reasons	Students Perceptions		
	Yes-f(%)	No- f(%)	Total
A. To enable students acquire a feel of phenomena they are studying.	20(20%)	80(80%)	100(100%)
B. To prepare students for K.C.S.E. Practical examinations.	07(07%)	93(93%)	100(100%)
C. To develop in the students the Habit of working as a scientist.	23(23%)	77(77%)	100(100%)
D. Develop a range of practical skills And techniques.	50(50%)	50(50%)	100(100%)

The data in table 4.3 above, shows that 50.0% of the YES responses indicated that practical work helps develop a range of practical skills and techniques. Another 20.0% felt that the reasons for doing practical work was to acquire a feel of phenomena being in studied. A smaller percentage of 23.0% of students were convinced that practical helps the learners to develop the habit of working as a scientist and a smaller percentage of 7.0% indicated that the reason for doing practical work is meanly to prepare the students for K.C.S.E. practical examinations. In the NO

category, 93.0% of the student's responses dismissed the assertion that physics practical work enables students acquire a feel of the phenomena under study. Another 77.0% of the students' responses did not believe that practical work helps the learners develop the habit of working as a scientist. A smaller percentage of 50.0% opposed the allegation that practical work helps the learners develop practical skills and techniques. However, in a special article written by Sinclair (1983) and published by Thomas Nelson and Sons Limited, practical work was considered to help students develop manipulative skills, develop the ability to record assessment accurately and make accurate deductions. However, this study is convinced that practical work enables students to develop a range of practical skills and techniques.

According to Shullman and Tamir (1973), Practical work appeals to students, improves their scientific skills and promotes the scientific culture: According to Anderson (1976) the reasons for administering practical work is to foster knowledge of science so to enhance students intellectual and aesthetic understanding, to foster science inquiry, to help the students appreciate science and in part inculcate the role of the scientist, to help the students appreciate the orderliness of scientific knowledge and nature of science.

According to Hudson (1980) some of the reasons for giving practical are to motivate students by stimulating interest, enjoyment to teach laboratory skills, to enhance the learning of scientific knowledge, to give thought into scientific method and develop expertise in using it. In addition practical work develops certain sacrifice attitudes such as open mindedness, objectivity and willingness to suspend judgement. According to Johnson, Swan and Monk (2000) the three reasons for going practical work are to reward students for good behavior, to allow students to work at their own

pace and to add variety to classroom activities. According to Miller (1991) the three reasons for doing practical work are to teach students to act like real scientist, to aid the learning of theory and teaches handling skills. According to Hudson (1993) Practical work motivates the learners.

According to Sterman (2008) many of the students in secondary schools in England spend more of their lessons doing practical work than many of their international counterparts. According to Wilkman (2001) practical work is used by teachers as a method of behavior management. In conclusion many students perceive the development of a range of practical skills and techniques as the main reasons for doing practical work in physics.

4.3.4. The Students perceptions of the functions of practical work in physics

In this sub-section, the students perceptions about the functions of practical work were collected and recorded in Table 4.4.

Table 4.4: Students perceptions of the functions of practical work in physics

Function for practical work	Students Perceptions		
	Yes-f(%)	No- f(%)	Total
A. It demonstrates theoretical ideas	11(11%)	89(89%)	100(100%)
B. It provides familiarities with the Apparatus.	50(50%)	50(50%)	100(100%)
C. It provides training on how to do experiments.	24(24%)	76(76%)	100(100%)
D. It trains students how to use instruments	15(15%)	85(85%)	100(100%)

The data presented in table 4.4 above shows that a large percentage of students (50.0%) believe that practical work familiarizes the students with the apparatus. Another 24.0% have the opinion that practical work provides some training on how to do experiments. A smaller percentage of 15.0% in the YES category held the view that practical work trains the students on how to use instruments, while a smaller percentage of 11.0% believes that practical work demonstrates theoretical ideas. On the other hand 89.0% of the responses in the NO category don't believe practical work demonstrates theoretical ideas.

Another 85.0% of the responses in NO category opposed the assertion that practical work trains students on how to use instruments as another 76.0% dismissed that the argument that practical work trains students on how to conduct experiments. An average percentage of 50.0% is reported to have opposed the assertion that practical work familiarizes the learners with apparatus. In a similar study conducted by SCORE (2007) practical work was reported to demonstrate theoretical ideas, familiarizes the students with apparatus, trains the students on how to do experiment and trains the learner on how to use various instruments in the laboratories. The researcher in the study is in agreement with the findings of SCORE.

According to Bernatte (2005) the functions of practical work are to encourage accurate observations, to make scientific phenomena more real, to enhance the understanding of scientific ideas, to arouse and maintain interest particularly in young pupils and to promote scientific method of thought. According to the Ministry of Education Science and Technology, the main functions for doing practical work in science are to encourage careful observation and accurate recording, to develop various manipulation skills, to arouse and maintain interest and an attitude of curiosity, to show what is meant by scientific experimentation, the proper use of controls and the presentation of data and finally to verify scientific facts and principles already taught.

According to Kerr (1963) practical work is done to encourage accurate observation and careful recording, to promote symbol common sense of thought, to develop manipulative skills, to guide training in problem solving, to fit the requirements of practical examinations, to elucidate theoretical work so as to aid comprehension to verify facts and principles already taught.

According to Wellington (1994) the function of practical work in physics is to arouse and maintain the interest in the subject, to encourage accurate observation and careful recording.

According to Duggan and Gott (1996) the function of practical work is to verify theory and illustrate concepts. Swan, Monk and Johnson (2000) noted that practical work in physics serves as a means of controlling behavior and as a strategy for dealing with mixed achieving classes.

According to Hudson (1990) the functions of practical work include stimulation of interest and enjoyment teaching laboratory skills of observation and measurement and enhancing the learning of scientific knowledge. In conclusion many students perceive practical work as a supporter of theory, motivator of students, developer of scientific knowledge and an enhancer of creativity.

4.3.5. The Students perceptions of the significance of practical work in physics

In this sub-section, student's perceptions of the significance of practical work in physics were collected and recorded in Table 4.5.

Table 4.5: Students perceptions of the Significance of practical work in physics

Significance of practical work	Students Perceptions		
	Yes-f(%)	No- f(%)	Total
A. It enables students to do physics rather than merely learning it	38(38%)	62(62%)	100(100%)
B. It provides the measuring skills in physics.	20(20%)	80(80%)	100(100%)
C. It prepares students for practical examinations.	27(27%)	73(73%)	100(100%)
D. It improves the skill of observing nature with alertness	15(15%)	85(85%)	100(100%)

A look at the data presented in table 4.5 above (38.0) of the students in the YES category hinted that practical work enables students to do physics. (27.0%) of the students were of the opinion that practical work prepares students for practical examinations while another 20.0% of the responses indicated that practical work provides the learners with measuring skills in physics and a small percentage (15.0%) improves the students ability to observes nature with alertness. On the other hand, improves the student's ability to observe nature with alertness. On the other hand, 85.0% of the responses in the NO category made it clear that practical work does not

improve the skills of observing nature with alertness. Another 80.0% the responses in the NO category was not convinced that practical work provides the learners with measuring skills, and 73.0% of the responses find it difficult to believe that practical work prepares learners for practical examinations, while a substantial percentage of 62.0% opposes the assertion that practical work enables students to do physics. In a similar study conducted by Tsuma (2006), practical work as observed to provide a means of directly obtaining facts about nature phenomena. According to Tsuma (2006) practical work also enables students to do science rather than merely learning about it. In addition Tsuma considers practical work as a reinforcer of theory learned in class.

According to Kerr (1964) practical work is done in physics to encourage accurate observations and description, make phenomena real arouse and maintain interest and promote a logical method of thought.

According to Woodley (2009) most teachers and researchers believe that effective practical work helps to develop important skills in understanding the process of scientific investigation and improves the students' grasp of concepts.

According to Scarlon (2002) Practical work helps to cultivate conceptual and procedural understanding of the science subject. However a substantial number of students perceive the significance of practical work as enabling students to do physics rather than merely learning it.

According to Miller (2014) effective practical work enables the students to built a bridge between what they can see and handle and the scientific ideas that account for their observations.

Meanwhile, the association for science Education is leading a new programmes of professional development called “Getting Practical” designed to support teachers and technicians to improve the effectiveness of Practical work through tailoring and managing of practical activities to meet particular aims.

4.3.6. The Students Perception of the Impact of Practical Work in Physics

In this subsection Students Perception of The Impact of Practical Work in Physics were collected and recorded in table 4.6 below;

Table 4.6: Students perceptions of the impact of practical work in physics

Impact of practical work	Students Perceptions		
	Yes-f(%)	No- f(%)	Total
A. It sharpens students skill in reading and writing	06(06%)	94(94%)	100(100%)
B. It help students to learn to think independently.	30(30%)	70(70%)	100(100%)
C. It provides the opportunity for students to handle instruments	09(09%)	91(91%)	100(100%)
D. It familiarizes student with proper Methods of observation and experimentation	55(55%)	45(45%)	100(100%)

The data presented in table 4.6 above shows that in the YES category, 55.0% of the students believe that practical work familiarizes students with proper methods of observation and experimentation. 30.0% were of the opinion that product work helps the students learn to think independently while the smaller percentages of 9.0% and

6.0% believe that product work provides opportunity for students to handle apparatus and sharpens the students' skills in reading and writing. On the other hand the table shows that in the NO category 94.0% disagree with the assertion that practical work sharpens students skills in reading and writing, 94.0% of other believe practical work provides an opportunity for student to handle instruments, 79.0% disagree with the allegations that practical work helps the learners to think independently and smaller percentage of 45.0% are doubtful of whether practical work familiarizes the students with proper methods of observation and experimentation.

In a similar study conducted by Lunetta (2007) in the UK practical work was believed to increase students sense of ownership and could increase their motivation. In a NESTA survey, 99.0% of the sample of the science teachers believed the practical work had an 83.0% impact on student performance and attainment.

According to the findings of the study conducted by Gibson and Chaise (2002) practical work stimulates interests in science and scientific careers among middle-school students. According to Millar (2004) practical work is essential for giving students a feel of phenomena. In his opinion, practical work is a tool for teaching about experiment design.

Many of the students interviewed have reported a change in culture after performing numerous experiments.

According to Daisy and Chernel (1986) practical work reduces boredom. In his opinion practical work is therefore seen by students as being an enjoyable activity, one that relieves the boredom of a lesson and improves the mastery of new concepts.

According to Gott and Duggan (2003), practical work is perceived to be a teaching and learning approach that develops procedural understanding as well as substantive understanding. It allows learning by doing and as an important experience of man's productivity and provides opportunities for significant learning. According to Bembambo (2008) practical work helps the learner to develop the thinking skills and problem solving skills.

According to Renner (1985) the majority of students are reported to have highly positive feelings towards practical work in school physics. The students think that practical work is important to their developing of understanding of concepts being taught.

4.3.7. The Students Perception of The Weaknesses of Practical Work in Physics

In this subsection, The Students Perception of The weaknesses of Practical Work in Physics were collected and recorded in Table 4.7.

Table 4.7: Students perceptions of the weaknesses of practical work in physics

Place of practical work	Students Perceptions		
	Yes-f (%)	No- f (%)	Total
A. It is closed, convergent and Dull	11(11%)	89(89%)	100(100%)
B. It assumes that scientific knowledge is subjective and detached.	50(50%)	50(50%)	100(100%)
C. It is much more a series of Restrictive exercises.	24(24%)	76(76%)	100(100%)
D. It has very little to do scientific activities	15(15%)	85(85%)	100(100%)

The data presented in table 4.7 above shows that in the YES category 50.0% responses believed that practical work in physics assumes that scientific knowledge is subjective and detached while a smaller percentage of 24.0% are of the opinion that practical work is much more a series of restrictive exercises. An even smaller percentage of 15.0% believes that practical work has very little to do with scientific activities. An even smaller percentage of 11.0% asserts that practical work is closed, convergent and dull. In the NO category, 89.0% responses were not convinced that practical work is closed, convergent and dull while another 85.0% dismissed the argument that practical work has very little to do with scientific activities. Another 76.0% in the NO category did not think that practical work is much more a series of

restrictive exercises. An average percentage of 50.0% argued that practical work does not assume that scientific knowledge is subjective and detached.

However, findings of study conducted in the United Kingdom by SCORE (2007) identified lack of support from government, school management team, student behaviour, content of curriculum, health and safety, lack of resources and facilities in most secondary school, cultural belief and practices, negative attitudes and the inability to improvise apparatus among other weakness. The findings of this study concur with SCORE conducted in the United Kingdom.

According to Woolnough and Allsops (1980) practical work in the majority of secondary schools worldwide are closed convergent and dull. According to Abdi El Khalid (1997) practical work is taught by teachers many of whom possess insufficient subject matter and knowledge of nature of science.

According to Kasanda (2008) many of the physics teachers lack content. This partly explains why there is poor content of knowledge at secondary school level. According to Watts (1988) most students complained that practical work lacked coherence or continuity.

In his study, Watt observed that students preferred laboratory activities to other activities because the laboratory activities help the students to remember concepts learnt in physics lessons. Laboratories activities and deemed to be less confusing and more concrete than others.

According to Gilbert and Jush (2005) it is important to use a variety of methods and instruments in order to gain a better understanding of the reality within science education.

4.3.8. The Students Perception of The Barriers to effective to Practical Work in Physics

In this subsection The Students Perceptions of The Barriers to effective to Practical Work in Physics were collected and presented in Table 4.8.

Table 4.8 The Students Perception of the Barriers to effective to Practical Work in Physics

Barriers to effective practical work	Students Perceptions		
	Yes f (%)	No.f (%)	Total
A. Too many students in practical class and associated behaviour problem	94(95%)	6(6%)	100(100%)
B. In appropriate assessment of practical Work.	70(70%)	30(30%)	100(100%)
C. Insufficient funding being devolved to Science department	91(91%)	9 (9%)	100(100%)
D. Under resourced and old fashioned laboratories	55(55%)	45(45%)	100(100%)

The data presented in table 4.8 above shows that 55.0% of the responses in the YES category indicated that many of the laboratories for conducting experiments are under-resourced and old fashioned. A large percentage of the students (91.0%) strongly felt that insufficient funding being devolved to science department in many of our secondary school is a major barrier to effective practical work. Another 94.0% of the students on the YES category felt that too many students in a practical class and

associated behaviour was major barrier to serious practical work. An average percentage 70.0% of the responses in the YES category were reported to have lamented that practical work is not assessed appropriately. In the NO category 45.0% of the students did believe that practical work is under resources and performed in old fashioned laboratories. Another 30.0% didn't agree with the assertion that the barrier to effective practical work is appropriate assessment. An even smaller percentage 9.0% of the students were of the opinion that insufficient funding to the science department is a barrier to effective practical work in physics. An negligible percentage of 6.0% is reported to have disagreed with those convinced that too many students in a class as a barrier to effective practical work. A similar study conducted by the Institute of Physics and reported to House of Lords (2007), identified five barriers to effective practical work, too many students in practical classes, inappropriate assessment of practical work, insufficient funding, old fashioned laboratories that are under resources and teachers who are not confident enough teaching physics.

According to Cook and Taylor (1994) lack of teacher's knowledge, skills and confidence restrict the amount of practical work performed in schools. According to Thair (1999) lack of laboratory facilities and technicians is one of the barriers to effective practical work.

According to Kemper (2009) Science teachers do not have enough time to do practical activities due to the overloaded curriculum.

According to Kobala and Tippens (2000) overloaded science curriculum compels teachers to focus more on the completing the syllabus than on the teaching methods. According to UNICEF (2010) barriers to effective use of practical work are classified

as physical, emotional and interactive barriers. First physical barriers include the setting arrangement in class, room space, physical space and the teaching and learning resources, crowded classrooms with inadequate furniture, tend to hide the learners and hence very little of their participation in lessons.

Emotional barrier may be caused by philosophical changes and situations in the home or society. Interactive barriers may arise from intimidative methodologies used which may undermine sexual and cultural background or abilities of learners, making them feel inferior and lowering their self-esteem.

4.4. The Teachers perceptions of practical work in Physics

This section is designed to address the second objective of this study that seeks to find the teachers perceptions of the importance and challenges of practical work in physics among secondary schools. This section consists of eight sub-sections:- Sub-section 4.4.1. presents, interprets and discusses the teachers perceptions of the meaning of practical work in Physics. Subsection 4.4.2. Presents, interprets and discusses the teachers' perception of the requirements of practical work. Subsection 4.4.3. Presents, interprets and discusses the teachers' perceptions of the reasons for doing practical work. Sub-section 4.4.4. Presents, interprets and discusses the teacher's perceptions of the functions of practical work. Subsection 4.4.5. Presents, interprets and discusses the teachers' perceptions of the significance of practical work. Subsection 4.4.6. Presents, interprets and discusses the teachers' perceptions of the impact of practical work in Physics. Subsection 4.4.7. Presents, interprets and discusses the teachers' perceptions of the weaknesses of practical work. The last Subsection 4.4.8. Presents, interprets and discusses the perceptions of the teachers on the barriers to effective practical work in Physics.

4.4.1. The Teachers' perceptions of the meaning of practical work in Physics

The Teachers' perceptions of the meaning of practical work in Physics were collected and recorded in Table 4.9.

Table 4.9. The Teachers' perceptions of the meaning of practical work in Physics

Meaning	Teachers Perceptions		
	Yes-f(%)	No- f(%)	Total
A. Practical work in Physics is a series of exercises.	01(05%)	19(95%)	20(100%)
B. Practical work in Physics is a series of investigations.	15(75%)	05(25%)	20(100%)
C. Practical work in Physics is a series of experiments.	03(15%)	17(85%)	20(100%)
D. Practical work is a series of tasks.	01(05%)	19(95%)	20(100%)

The data presented in table 4.9 above shows that 75.0% of the responses in the YES category indicated that practical work is a series of investigations. Another 15.0% held the opinion that practical work is a series of experiments while 5.0% believed that practical work is a series of tasks and another 5.0% were convinced that practical work in physics is a series of exercises. However, in the NO category, 95.0% of the teachers were of the opinion that practical work cannot be a series of tasks alone. 85.0% were opposed to the assertion that practical work is a series of experiments.

95.0% do not believe that practical work is a series exercises and small percentage 25.0% disagreed with the assertion that practical work is a series of investigations. On the whole the majority of teachers in the YES category believe that practical work is a series of investigations. In a similar study conducted by Lunetta (2007) practical work was defined as learning experiences in which students interact with materials or with secondary sources of data to observe and understand the natural world. In another similar study Robin Miller (2010) ended up defining practical work as any science teaching and learning activity in which the students, working individually or in small groups handle or observe the objects or materials they are studying. Since research has shown that a variety of terms exist to describe practical work many of which are frequently used with little clarification, this study defines practical work as a series of exercises, investigations experiments and tasks designed to give the students practiced in developing scientific skills and competences and exploring skills.

According to Miller (1999) the term practical work is used to refer to laboratory activities that include lectures, group experiments and teacher demonstrations where learners are involved in handling and observing real objects and materials. In a similar study conducted in Ethiopia by Bakalo and Welford (2000) the findings indicated Ethiopian science teachers perceive practical work in science to be laboratory work only, involving relatively sophisticated and imported expensive apparatus.

According to Lunetta (2007) in his most recent publication, most science teachers view science work as learning experiences in which student interact with materials or with secondary sources of data to observe and understand the natural world.

According to Hudson (1990) practical work is a series of tasks in which students observe and manipulate real objects or materials for themselves. Generally, practical

work refers to tasks in which students observe and manipulate real objects or materials they witness teacher demonstrations.

4.4.2. The Teachers' perceptions of the Requirement of practical work in Physics

Table 4.10: Teachers perception of the requirements of practical work in physics

Requirements	Teachers Perceptions		
	Yes-f(%)	No- f(%)	Total
A. Practical work in Physics			
Requires adequate apparatus.	01(05%)	19(95%)	20(100%)
B. Practical work in Physics requires			
careful preparation before hand .	07(35%)	13(65%)	20(100%)
C. Practical work in Physics requires			
Good organization throughout.	10(50%)	10(50%)	20(100%)
D. Practical work requires well			
trained teachers.	02(10%)	18(90%)	20(100%)

The data presented in table 4.10 shows that 50.0% of the responses in the YES category believe that practical work in physics requires good organization throughout; another 35.0% are of the opinion that practical work requires careful preparation before hand. A small percentage (10.0%) of the teachers indicated that practical work requires well trained teachers and even smaller percentage of 5.0% of the teachers held the opinion that practical work requires adequate apparatus. On the other hand 95.0% of the teachers in the NO category believe that practical work does not necessarily require adequate apparatus. Another 90.0% of the responses in the NO category disagreed with the assertion that practical work requires well trained

teachers, while 65.0% of the responses opposed the assertion that practical work requires careful preparation before hand, as another 50.0% were doubtful as to whether practical work requires good organization throughout. In a similar study conducted by SCORE (2007) in the United Kingdom, it was proposed that practical work requires adequate apparatus, careful preparation, good organization and well trained teachers and technicians. This study wishes to echo the finding of the SCORE report and emphasize that this is the way to go.

According to Farrant (1994) practical work requires careful preparation and organization before hand to provide an activity that is profitable and emotionally satisfying. In a SMASSE used workshop hosted by Kakamega High School in 1999, it was pointed out that time is an important resource in organizing and obtaining good practical results. According to Twoli (2006) a good practical activity requires concise statements of objectives to guide the students focus, explicit procedures for guiding the acquisition of objective, schematic illustration of apparatus, set up itemized list of materials, data entry facilities usually given in tabular form, report discussion and interpretation of the findings. According to Boz and Boz (2008) a teacher should initially be equipped with adequate subject matter to be able to teach any discipline.

According to De Vos (1998) such knowledge is a precondition for teachers to be able to understand the learner's difficulties. However, the findings of this study show that most teachers perceive good organization as one of the requirements of a practical lesson.

4.4.3. The Teachers' perceptions of the Reasons for doing Physics practical work

In this subsection, the teachers perception of the reasons for doing practical work in Physics were collected and recorded in Table 4.11.

Table 4.11: Teachers perceptions of the reasons for doing practical work in physics

Reasons	Teachers Perceptions		
	Yes-f(%)	No- f(%)	Total
A. To enable students acquire a feel of phenomena they are studying.	07(35%)	13(65%)	20(100%)
B. To prepare students for K.C.S.E. Practical examinations.	02(10%)	18(90%)	20(100%)
C. To develop in the students the Habit of working as a scientist.	03(15%)	17(85%)	20(100%)
D. Develop a range of practical skills And techniques.	08(40%)	12(60%)	20(100%)

The data presented in table 4.11 above shows that only 40.0% of the teachers in the YES category think practical work helps to develop a range of practical skills and techniques. Another 35.0% of the responses in the YES category indicated that the reason for doing practical work is to enable students acquire a feel of phenomena they are studying. A small percentage 15.0% of the teachers in the YES category were of the opinion that practical work helps the students to develop the habit of working as a scientist while 10.0% held that view that practical work in physics helps the students

prepare for KCSE practical paper 232/3. A closer look at the data in the table shows that 90.0% of the responses in NO category disagree with the assertion that practical work helps students prepare for KCSE practical paper 232/3 while another 85.0% appear to suggest that practical work does not help the students develop the habit of working as scientist. A larger percentage of the responses in the NO category (65.0%) did not think that practical work helps students to acquire a feel of phenomena they are studying and finally an average of 60.0% appeared to have disagreed with the assertion that practical work helped students to develop a range of practical skills and techniques. In an article written by Sinclair and published by Thomas Nelson and Sons (1983) some of the reasons for doing practical work is to help the students develop the ability to record observations, to manipulate skills and enable accurate deductions. This seems to agree with the researchers' argument that practical work helps the students to develop a range of practical skills and techniques.

According to Shullman and Tamir (1973) the reasons for doing practical work include arousing and maintaining interest attitudes, satisfaction and curiosity in science, developing creative thinking and problem solving ability, promoting aspects of scientific thinking and methods, like formulating hypothesis and making assumptions developing conceptual understanding and intellectual ability and to develop practical abilities like designing and executing investigations, making observation recording data and analyzing and interpreting results. According to Anderson (1976) the reasons for doing practical work include fostering knowledge of the human enterprises of science, and enhance student intellectual and aesthetic understandings to foster science inquiry, skills that can be transferred to other spheres of problem solving, to help students appreciate and emulate the role of the students and help the learners

grow in both in appreciation of the orderliness of scientific knowledge and the tentative nature of scientific theories and models.

According to Hodson (1980) the reasons for teachers administering practical work include motivating students by stimulating interest and enjoyment teaching laboratory skills, enhancing learning of scientific knowledge attitudes such as open mindedness, objectivity and willingness to suspend judgement.

According to Swan Monk and Johnson (2000) the three reasons for doing practical work as a way of rewarding students for good behavior to allow students to work at their own pace and to add variety to classroom activities

4.4.4. The Teachers perception of the Functions of Practical work in Physics

In this subsection, the Teachers perception of the functions for doing practical work in Physics were collected and recorded in Table 4.12.

Table 4.12: Teachers perceptions of the functions of practical work in physics

Function for practical work	Teachers Perceptions		
	Yes-f(%)	No- f(%)	Total
A. It demonstrates theoretical ideas	01(05%)	19(95%)	20(100%)
B. It provides familiarities with the Apparatus.	08(40%)	12(60%)	20(100%)
C. It provides training on how to do experiments.	10(50%)	10(50%)	20(100%)
D. It trains students how to use instruments	01(05%)	19(95%)	20(100%)

The data presented in table 4.12 above shows 50.0% of the responses in the YES category were of the opinion that one of the function of practical work is to train students on how to do experiments. A smaller percentage of the teachers' responses (40.0%) thought that practical work provides the students with the opportunity to familiarizes with apparatus. An even smaller percentage of (5.0%) work of the opinion that practical work helps to demonstrate theoretical ideas while another (5.0%) indicated that practical work trains students how to use instruments. However, in the same table 95.0% of the responses of the teachers in the NO category did not agree with the assumption that practical work really demonstrate theoretical ideas while another 95.0% did not agree with the statement that practical work trains

students how to use instruments. In a study conducted by West (1972) the learning experiences of a students in the laboratory is regarded as arising from the interaction between the student, the teacher and the apparatus. In another similar study conducted by SCORE (2007), it was reported that the functions of practical work was to demonstrate theoretical ideas, to familiarize the students with apparatus, to train the students on how to use instruments. Some of the functions of practical work is echoed by the findings of the study. According to Denny and Chemel (1986) the overriding functions of practical work are to learn about science, to reduce boredom and a means of developing personal well-being.

According to Tobin (1986) most science teachers think practical work is an effective way to learn science and physics. According to Tobin lower achievers tended to lose track of experiments performed. In his findings, teachers were of the view that boys are more likely to engage in activities which facilitate science learning to a greater extent than girls. Girls are believed to express the desire to work in mixed groups as they perceive the boys as being better than they were in science. According to responses of teachers, most girls are reported to perform better than boys across most of the skill areas tested with significance differences.

According to Hofstein (1998) teachers are said to be convinced that students enjoy what they are doing in the laboratory even if difficulties arose in the procedures. According to Woolnough and Alsops (1985) many science teachers recognize the importance of practical work. Most teachers believe that students should have first hand practical experience in laboratories in order to acquire skill in handling apparatus to measure and illustrate concepts and principles. According to Romorogo

(1998) the two serious impediments to teachers in Botswana are lack of laboratory assistants and shortage of laboratories.

According to Gott and Duggan (1999) the function of practical work is to verify theory and illustrate concepts as is routine and repetitive. According to Benatte (2005) the functions of physics practical work include encouraging accurate observations to make scientific phenomena more real to enhance understanding of scientific ideas to arouse and maintain interest particularly in young students and to promote scientific method of thought.

4.4.5. The Teachers perception of the Significance of Physics Practical work

In this subsection, the Teachers Perception of The Significance of practical work in Physics were collected and recorded in Table 4.13.

Table 4.13: Teachers perceptions of the Significance` of physics practical work

Significance of practical work	Teachers Perceptions		
	Yes-f(%)	No- f(%)	Total
A. It enables students to do physics rather than merely learning it	10(50%)	10(50%)	20(100%)
B. It in calculates the measuring skills in physics.	05(25%)	15(75%)	20(100%)
C. It prepares students for practical examinations.	03(15%)	17(85%)	20(100%)
D. It improves the skill of observing nature with alertness	02(10%)	18(90%)	20(100%)

the data presented in table 4.13 above shows that 50.0% of the teachers response in the YES category thought that practical work enable students to do physics rather than merely learning it, 25.0% of the responses believed that practical work inculcates measuring skills, 15.0% held the opinion the practical work prepares students for practical examinations and 10.0% of the teachers were of the opinion that practical work enables the students to improve their skills of observing nature with alertness. On the contrary, 90.0% of the responses in the NO category indicated that practical work improves the skill of observing nature with alertness, while 85.0% of all the responses held the opinion that practical work prepares students for practical examinations. A closer look at this data shows that 75.0% of the responses in the NO category thought that practical work inculcates measuring skills in physics and another 50.0% were of the opinion that practical work enables students to do physics rather than merely learning it. In a similar study conducted by Tsuma (2006), practical work was deemed to enable students to do science rather than merely learning it. In addition Tsuma further observe that in practical work in secondary school helps to reinforce the theory learned in class along experience of teaching is mentioned to be an advantage because it contributes to good mastery of content by a teacher.

According to Kerr (1964) the importance of a well designed practical activity is to encourage accurate observations and make phenomena more real to arouse and maintain interest and promote a logical method of thought. In a study conducted by Lunetta (2007) practical work that is well planned and effectively implemented has a significant impact or the learner.

Gunstav (1990) observe that practical work enables students to manipulate materials as well as ideas and increase their sense of ownership of the learning process and increase their motivation.

In a study conducted in 2014 by Millar it was observed that an effective practical work enables the students to build a bridge between what they can see and handle and scientific ideas that account for their observations. Meanwhile these are reports that the Association for Science Education as leading a new programme of professional development called “Getting Practical”. The programme is designed to support teachers and technicians to improve the effectiveness of practical work through the tailoring and management of practical activities to meet particular aims. According to Woodley (2009) most teachers of science and researchers believe that effective practical work can develop important skills in understanding the process of scientific investigations and develop students’ grasp of concepts. The majority of teachers who participated in this study reported that in their opinion practical work in physics enables the learners to do physics rather than merely learning it.

4.4.6. The Teachers perceptions of the Impact of physics practical work

In this subsection, the Teachers Perception of The Impact of practical work in Physics were collected and recorded in Table 4.14.

Table 4.14: Teachers perceptions of the impact of practical work in physics

Impact of practical work	Teachers Perceptions		
	Yes-f(%)	No- f(%)	Total
A. It sharpens students skill in reading and writing	01(05%)	19(95%)	20(100%)
B. It help students to learn to think independently.	05(25%)	15(75%)	20(100%)
C. It provides the opportunity for students to handle instruments	03(15%)	17(85%)	20(100%)
D. It familiarizes student with proper Methods of observation and experimentation	11(55%)	09(45%)	20(100%)

The data presented in table 4.14 above shows that 55.0% of the responses in the YES category strongly felt that practical work in physics familiarizes students with proper methods of observation and experimentation a smaller percentage of 25.0% held the opinion that practical work helps the students to learn to think independently and 15.0% of the responses were of the opinion that practical work provides the students with an opportunity to handle instruments. A smaller percentage (5.0%) of the responses in the YES category believe that practical work in physics sharpens students skill in reading and writing. On another hand the data indicated that 95.0%

disagreed with the assertion that practical work sharpens students' skill in reading and writing while another 85.0% of the responses in the NO category questioned the argument that practical work provides the students with the opportunity to handle instruments. Another percentage (75.0%) of the teachers were reported to have dismissed the assertion that practical work helps students to learn to think independently. However, in a similar study conducted by Lunetta (2007) in the United Kingdom practical work was reported to increase the student's sense of ownership and can increase their motivation. In a recent survey by NESTA science teachers were convinced that practical had about 83.0% impact on student performance and attainment. In another study by Eryitmazandelase (1999) observed that the characteristics of the teachers play a big role in the impact of practical work.

According to Gott and Duggan (2003) Practical work is a teaching and learning approach that develops procedural understanding as well as substantive understanding. Practical work allows learning by doing and is an implicit experience of our particularly and provides opportunities for significant learning.

According to Millar (2014) effective practical work enables students to build a bridge between what they can see and handle and scientific ideas that account for their observations.

According to the findings of the study conducted by Gibson and Chaise (2004) physics practical work stimulates interests in science and scientific careers among middle school students.

Similarly Millar (2004) admits that Practical work is essential for giving students a feel of phenomena. Practical work therefore, is viewed as a tool for teaching about

design of experiment. Many studies and report have reported an attitudinal change in the manner in which practical work is executed in many secondary schools. In essence students have to be allowed time to use the ideas associated with observed phenomena rather than seeing the phenomena as an end in itself.

4.4.7. The Teachers perceptions of the Weaknesses of physics practical work

In this subsection, the Teachers Perception of The Weaknesses of practical work in Physics were collected and recorded in Table 4.15.

Table 4.15: Teachers perceptions of the place of Weaknesses practical work in physics

Place of practical work	Teachers Perceptions		
	Yes-f(%)	No- f(%)	Total
A. It is closed, convergent and Dull	01(05%)	19(95%)	20(100%)
B. It assumes that scientific knowledge is objective and detached.	08(40%)	12(60%)	20(100%)
C. It is much more a series of Restrictive exercises.	10(50%)	10(50%)	20(100%)
D. It has very little to do scientific activities	01(05%)	19(95%)	20(100%)

The data presented in table 4.15 above on one hand shows that 50.0% of the responses in the YES category indicated that practical work is much a series of restrictive exercises while 40.0% of the same category were of the opinion that practical work assumes that scientific knowledge is subjective and detached. A closer look at the data further reveals that 5.0% of the responses in the YES category believed that practical

work is closed, convergent and dull, while another 5.0% held the view that practical work had very little to do with scientific activities. On the other hand, 95.0% of the responses in the NO category were convinced that practical work is neither closed, convergent and dull nor had very little to do with scientific activities. A closer look at the remaining responses in the NO category shows that 60.0% of the responses were reported to be against the assertion that practical work is subjective and detached and a further 50.0% of the responses that held the view that practical work is a series of restrictive exercises. However, in presently the finding of it's study SCORE (2007) identified lack of support from Government, student behaviour, the content of the curriculum, lack of time, lack of resources and facilities, cultural belief, negative attitudes and the failure of teachers to improvise apparatus among many other weaknesses.

According to Romorogo (1998) the two serious impediments to the use of practical work in Botswana are lack of laboratory assistants and shortage of laboratories.

According to Leah (1999), teachers in many countries spend considerable amount of time in supervisory practical work. In addition the assessment the students work was by large neglected in most countries and by most teachers. According to Woolnough and Allsops (1980) physics practical work in the majority of secondary school is closed, convergent and dull. According to Kasanda (2008) many of the physics teachers lack the subject content. Many of the researchers argue that many of the science teachers possess insufficient subject matter to be able to deliver well-thought out practical work.

According to activities to Woolnough (1991) practical activities should be designed in such a way as to develop the higher cognitive abilities that underpin scientific

problem solving skills. Despite this conviction of significant proportion of the practical activities remain highly presumptive and therefore failed to challenge the secondary school science students.

4.4.8. Teachers perceptions of the Barriers to effective practical work in physics

In this subsection, the Teachers Perception of The barrier to effective practical work in Physics were collected and recorded in Table 4.16.

Table 4.16. Teachers perceptions of the Barriers to effective practical work in physics

Barriers to effective practical work	Teachers Perceptions		
	Yes f(%)	No. f(%)	Total
a) Too many students in practical class and associated behaviour problem	19(95%)	1(5%)	20(100%)
b) In appropriate assessment of practical work	15(75%)	5(25%)	20(100%)
c) Insufficient funding being devolved to Science department	17(85%)	3(15%)	20(100%)
d) Under resourced and old fashioned laboratories	11(55%)	9(45%)	20(100%)

The data presented in table 4.16 above shows that 95.0% of the responses in the YES category indicated that one of the barriers to effective practical work is too many students in practical class and the associated behavior problem. About 85.0% of the responses held the view that insufficient funding from schools and government to science departments in another major barrier to effective practical work. Of the

remaining YES category, 75.0% were of the opinion that another barrier to practical work in physics is the inappropriate assessment of practical work. The remaining 55.5% of the responses strongly believed that one other barrier to effective practical work is under-resourcing and use of old fashioned laboratories. However, a 45.0% of the responses in the NO category indicated under resourcing of Science and use of old fashioned laboratories are not of the major barriers to effective practical work.

Another, 25.0% of the responses in the NO category held the view that practical work is assessed using inappropriate assessment methods. Out of the remaining responses, 15.0% were of the opinion that practical work is not given sufficient. Finally, a small percentage 5.0% of the responses in the NO category, didn't believe that too many students in a practical class could not be a serious barrier to effective practical work. In a similar study conducted in the Institute of Physics in UK, five barriers to effective practical work were identified and listed as too many students on a practical class, inappropriate assessment of practical work, insufficient funding to science department, under-resourcing and use of old fashioned laboratories and teachers who are not confident teaching physics.

According to Thair and Treagurt (1999) some of the barriers to effective practical work are lack of laboratory facilities and lack of laboratory assistants and requiring teachers to spend long hours preparing for practical lessons.

According to Cook and Taylor (1994) lack of confidence at knowledge on the part of the teachers restricts the amount of practical work that can be done.

However, in this study the teachers' responses show that the majority of teachers (95%) perceive too many students in practiced classes as a serious drawn back to effective teaching of a practical lesson.

In the year 2009 Kemper noted that most science teachers do not have time to do practical activities due to the overloaded curriculum.

According to Kabala and Toppins (2000) overloaded science curricular focused on completing the syllabus than on using methods of science teaching.

4.5. The Female students' perceptions of Physics practical work

This section is designed to address the third objective of this study that seeks to investigate the female student's perceptions of the importance and challenges of physics practical work in secondary schools.

This section consists of eight sub-sections:- Sub-section 4.5.1. presents, interprets and discusses the female perceptions of the meaning of practical work in Physics. Subsection 4.5.2. Presents, interprets and discusses the female perception of the requirements of practical work. Subsection 4.5.3. Presents, interprets and discusses the female perceptions of the reasons for doing practical work. Sub-section 4.5.4. Presents, interprets and discusses the female perceptions of the functions of practical work. Subsection 4.5.5. Presents, interprets and discusses the female perceptions of the significance of practical work. Subsection 4.5.6. Presents, interprets and discusses the female perceptions of the impact of practical work in Physics. Subsection 4.5.7. Presents, interprets and discusses the female perceptions of the weaknesses of practical work. The last Subsection 4.5.8. Presents, interprets and discusses the perceptions of the female on the barriers to effective practical work in Physics.

4.5.1. The female students' perceptions of the meaning of practical work

In this subsection, the Female Perception of meaning practical work in Physics were collected and recorded in Table 4.17.

Table 4.17: Female students' perception of the meaning of practical work in physics

Meaning	Female Perceptions		
	Yes-f(%)	No- f(%)	Total
A. Practical work in Physics is a series of exercises.	01(04%)	50(96%)	51(100%)
B. Practical work in Physics is a series of investigations.	26(50%)	25(49%)	51(100%)
C. Practical work in Physics is a series of experiments.	10(20%)	41(80%)	51(100%)
D. Practical work is a series of tasks.	02(04%)	49(96%)	51(100%)

The data presented in table 4.17 above shows that 50.0% of the female students engaged in the study believed practical work is a series of investigations. Another 20.0% of the responses of female students held the view that practical work is a series of experiments. A smaller percentage of 4.0% of the responses in the YES category considered practical work as a series of exercises. Another 4.0% of the responses in the YES category were of the opinion that practical work is a series of tasks.

In the NO category, 96.0% of the responses supported the view that practical work is a series of exercises and another 96.0% of the responses indicated that practical work

is a series of tasks. A significant percentage (80.0%) of the NO responses were recorded as supporting the belief that practical work in Physics is a series of experiments. An average percentage of 49.0% of these responses in the NO category held the opinion that practical is a series of experiments. In a similar study conducted in United Kingdom (2007) by the Science Community Representing Education (SCORE) it was learned that practical work has a variety of existing definitions many of which are frequently used with little clarification. However, the most recent published review of the literature on teaching and learning in the school of science is that practical work is defined as learning experiences in which students interact with materials or with secondary sources of data to observe and understand the natural world. It is the view of the study that this definition might act as a starting point for clarifying the term practical work in science education.

According to Lunatta (2007) practical work can be defined as learning experiences in which students interact with materials or with secondary sources of data to observe and understand the natural world.

According to Millar and Tebergren (1999) the term practical work is used to refer to laboratory activities that include lectures, group experiments and teacher demonstrations where learners are involved in handling and observing real objects and materials. In a study conducted in Ethiopia by Bakala and Wellford (2006) the scientific teacher perceived practical work as laboratory work involving relatively sophisticated and imported expensive apparatus. However, practical work refers to tasks in which students observe or manipulate real objects or materials or they witness teacher demonstrations.

Generally, practical work is perceived to be any science teaching and learning activity in which the students working individually or in small groups handle or observe the objects or materials they are studying.

According to Millar (1985) female students perceive practical work to be an aid to learning and understanding science concepts and their meanings. The students see teachers' demonstrations as inadequate and a substitute for hands on practical work. However the majority of females in this study were of the opinion that practical work is a series of investigations.

4.5.2. The female perceptions of the requirement of practical work

In this subsection, the Female Perception of meaning practical work in Physics were collected and recorded in Table 4.18.

Table 4.18: Females students' perception of the requirements of practical work in physics

Requirements	Female Perceptions		
	Yes-f(%)	No- f(%)	Total
A. Practical work in Physics Requires adequate apparatus.	08(16%)	43(84%)	51(100%)
B. Practical work in Physics requires careful preparation before hand .	12(24%)	39(76%)	51(100%)
C. Practical work in Physics requires Good organization throughout.	17(33%)	34(67%)	51(100%)
D. Practical work requires well trained teachers.	03(05%)	48(94%)	51(100%)

As shown in table 4.18 a good number of females in the YES category (33.0%) felt that any successful practical work in physics requires good organization. About 24.0% of the YES responses were of the opinion that practical work requires careful preparation before hand. A similar percentage (16.0%) of the YES responses held the view that practical work requires adequate apparatus while an even smaller percentage of 5.0% believed that practical work requires well trained teachers. On the other hand 94.0% of the responses in the NO category dismissed the belief that practical work requires well trained teachers as another 84.0% doubted that practical work requires adequate apparatus. A closer look at the data also shows that 76.0% of the responses in the NO category require careful preparation before hand, while 67.0% of the NO responses held the view that practical work requires good organization throughout. However, in a study conducted by SCORE, the requirements for practical work are adequate apparatus, careful preparation before hand, good organization and well trained teachers.

According to Farrat (1964) a good practical activity requires adequate apparatus, careful preparation before hand, good organization throughout and well trained teachers. According to Twoli (2006) a good practical activity requires concise statements of objectives to guide the students from explaining procedures that guide the acquisition of objectives schematic illustration of apparatus set up itemized list of materials, data entry facilities usually given in tabular form, report discussion and interpretation of the findings.

According to Boz and Boz (2008) a teacher should be equipped with adequate subject matter to be able to teach any discipline.

According to DeVos (1999) such knowledge is a precondition for teachers to be able to understand the difficulties of the learners. Generally the majority of female students seem to agree that practical work requires good organization throughout.

4.5.3. The female students' perceptions of the reasons of practical work

In this subsection, the Female Perception of meaning practical work in Physics were collected and recorded in Table 4.19.

Table 4.19: Females students' perception of the reasons for practical work in physics

Reasons for practical work	Female Perceptions		
	Yes-f(%)	No- f(%)	Total
A. To enable students acquire a feel of phenomena they are studying.	08(16%)	43(84%)	51(100%)
B. To prepare students for K.C.S.E. Practical examinations.	05(10%)	46(90%)	51(100%)
C. To develop in the students the Habit of working as a scientist.	07(14%)	44(86%)	51(100%)
D. Develop a range of practical skills And techniques.	20(39%)	31(61%)	51(100%)

The data presented in the table 4.19 above shows that 39.0% of the responses in the YES category indicated that practical work helps the students to develop a range of practical skills and techniques while 16.0% of the responses hold the opinion that practical work enables the students acquire a feel of phenomena they are studying. A

closer look at the data shows that 14.0% of the responses supported the argument that practical work helps the students develop the habit of working as scientists while a lower percentage for KCSE practical examinations. In an article written by Sinclair (1973) and published by Thomas Nelson Ltd the reasons for doing practical work are to help students develop manipulation skills, the ability to record observation accurately and make accurate deductions.

According to Shulman and Tamir (1973) the reasons for doing practical work include the arousing and maintaining of interest attitude satisfaction and curiosity in science.

Furthermore, practical work helps develop creative thinking and problem solving ability promoting aspects of scientific method like formulating hypothesis and making assumptions. According to Anderson (1976) the reasons for doing practical work is to foster knowledge of the human enterprises of science and enhances students intellectual and aesthetic understanding.

According to Swan, Monk and Johnson (2000) the three reasons for administering practical work physics are to reward students for good behavior is to allow students work at their own pace and to add variety to classroom activities.

According to Hudson (1980) the teachers reasons for administering of practical work includes motivation of students by stimulating interest and enjoyment to teach laboratory skills to enhance the learning of scientific knowledge to give insight into scientific method and help the learners to develop certain scientific attitudes such as open mindedness objectivity and willingness to suspend judgement.

However the findings of this study show that most female students perceive practical work as a tool to develop a range of practical skills and techniques.

Which are partly in agreement with research findings.

4.5.4. The female students' perceptions of the functions of practical work

In this subsection, the Female Perception of meaning practical work in Physics were collected and recorded in Table 4.20.

Table 4.20: Females students' perception of the functions of practical work in physics

Function for practical work	Female Perceptions		
	Yes-f (%)	No- f (%)	Total
A. It demonstrates theoretical ideas	33(65%)	18(35%)	51(100%)
B. It provides familiarities with the Apparatus.	00(0%)	51(100%)	51(100%)
C. It provides training on how to do experiments.	06(12%)	45(88%)	51(100%)
D. It trains students how to use instruments	01(02%)	50(98%)	51(100%)

The data presented in table 4.20 above shows that 65.0% of the responses in the YES category and 35% of the responses in the NO category supported and opposed the assertion that practical work is used to demonstrate theoretical ideas respectively. A closer look at the data reveals that 12.0% of the female responses supported the argument that practical work trains students how to use instruments while 2.0% supported the argument that practical work trains students how to use instruments while 0.0% of the YES responses backed the assertion that practical work familiarizes the students with the scientific apparatus. However, 98.0% of the female dismissed

the argument that practical work trains students on how to use instruments, while all the females approved the statement that practical work provides familiarization with apparatus. A closer look at the showed that 88.0% of the females did not agree with the statement that practical work trains the students on how to do experiments. An even smaller percentage (35.0%) of the female response dismissed the argument that practical work is used to demonstrate theoretical ideas. According to Justin Dillon, (2008), of kings College London the purposes for doing practical work in school science are to encourage accurate observations and descriptions, to make phenomena more real, to arouse and maintain to promote logical and reasonable methods of thought.

According to Hodson (1990) the functions of physics practical work include motivation of students by stimulating interest and enjoyment. Teaching of laboratory skills enhancing the learning of scientific knowledge, giving insight into scientific method and developing expertise; and developing scientific attitudes such as open mindedness and objectivity.

According to Wellington (1994) the functions of practical work include arousing and maintaining the interest of students in the subject, and to encourage accurate observation and careful recording. According to Gott and Duggan (1996) practical work in physics serves to verify theory and illustrate concepts.

4.5.5. The female students' perceptions of the significance of practical work

In this subsection, the Female Perception of meaning practical work in Physics were collected and recorded in Table 4.21.

Table 4.21: Females students' perception of the significance (importance) of practical work in physics

Importance of practical work	Female Perceptions		
	Yes-f(%)	No- f(%)	Total
A. It enables students to do physics rather than merely learning it	17(33%)	34(67%)	51(100%)
B. It in calculates the measuring skills in physics.	07(13%)	44(87%)	51(100%)
C. It prepares students for practical examinations.	08(16%)	43(84%)	51(100%)
D. It improves the skill of observing nature with alertness	08(16%)	43(84%)	51(100%)

The data presented in table 4.21 above shows that 33.0% of the responses in the YES category indicated that practical work enables students to do physics rather than merely learning it while 67.0% dismissed that assertion. The number of YES responses that supported the statement that practical work prepares students for practical was 16.0% while another 16.0% of the responses in the YES category showed that 16.0% some of the female responses agreed with assumption that practical work improves the skills of observing nature will alertness. However, 87.0%

of responses in the NO category dismissed the argument that practical work inculcates measuring skills while 84.0% did not believe that practical work improves the skill of observing nature with alertness and another 84.0% of the responses did quite agree with the argument that practical work prepares students for practical examinations. Finally, the table shows that 67.0% of the responses in the NO category did not quite believe that practical work enables the students to do physics rather than merely learning it. In similar study conducted by Tsuma (2006), practical work provides a means of obtaining facts about natural phenomena and also enables students to do science rather merely learning it. In addition Tsuma believes that practical work is used to reinforce theory.

According to Hudson D. (1990) in his work entitled critical look at practical work in school science. Practical work can motivate students by stimulating interest and enjoyment, teach laboratory skill and enhance the learning of scientific knowledge, gives insight into scientific methods and develop expertise in using it; then develop scientific attitudes such as open mindedness and objectivity. According to Kerr (1964) practical work is used in physics to encourage accurate observations and make phenomena more real; arouse and motivate interest and promote a logical method of thought.

4.5.6. The female students' perceptions of the impact of practical work

In this subsection, the Female Perception of meaning practical work in Physics were collected and recorded in Table 4.22.

Table 4.22: Females students' perception of the impact of practical work in physics

Impact of practical work	Females Perceptions		
	Yes-f(%)	No- f(%)	Total
A. It sharpens students skill in reading and writing	02(04%)	49(96%)	51(100%)
B. It help students to learn to think independently.	14(27%)	37(73%)	51(100%)
C. It provides the opportunity for students to handle instruments	01(02%)	50(98%)	51(100%)
D. It familiarizes student with proper Methods of observation and experimentation	28(55%)	23(45%)	51(100%)

The data presented in table 4.22 above indicated low percentages in the YES category and high percentage in the NO category. It is noteworthy that 55.0% of the females interrogated, agreed that practical work familiarizes students with proper methods of observation and experimentation while 27.0% thought that practical work helped students learn to think independently. However, a negligible percentage of 4.0% thought the practical work sharpens students' skill of reading and writing while a very low percentage of 2.0% of the responses seemed to agree with the assertion that

practical work provides opportunities for students to handle instruments. On the other hand very high percentages of 98.0%, 96.0%, 73.0% and 45.0% disagreed with the argument that practical work provides opportunity for students to handle instruments, sharpens students skills of reading and writing helps students to learn, to think independently and familiarizes students with proper methods of observation and experimentation respectively. According to report by NESTA (2005) practical work has a positive impact on students' performance and attainment. There is a growing body of research that shows the effectiveness of hand on and trains activities in school science inside and outside the laboratory. There is evidence that practical work increases students sense of ownership of their learning and can increase their motivation. In a study conducted by Kerr (1963) in England and Wales the values of practical work include motivation, support theory development of skill and acquiring the scientific approach.

According to Eryimazande (1999) science teachers should be informal of the qualities of an effective teacher to be able to impact positively on learners.

According to Millar (2014) effective practical work enables students to build a bridge between what they can see and handle and scientific ideas that account for their observations. Generally allowing time for students to use the ideas associated with observed phenomena as an end in itself, if students are to make useful links.

4.5.7. The female students' perceptions of the weaknesses of practical work

In this subsection, the Female Perception of meaning practical work in Physics were collected and recorded in Table 4.23.

Table 4.23: Females students' perception of the weaknesses of practical work in physics

Weakness of practical work in physics	Female Perceptions		
	Yes f(%)	No. f(%)	Total
A. It is closed, convergent and Dull	02(3.9%)	49(96.1%)	51(100%)
B. It assumes that scientific knowledge is subjective and detached	14(27.5%)	37(22.5%)	51(100%)
C. It is much more a series of Restrictive exercises.	01(1.9%)	50(88.1%)	51(100%)
D. It has very little to do scientific activities	28(54.9%)	23(45.1%)	51(100%)

The data presented in table 4.23 above indicated clearly that 54.9% of the female students strongly believe that practical work has very little to do with scientific activities while 27.5% assume that scientific knowledge is subjective and detached. In addition (3.9%) of the female students thought that practical work is closed, convergent and dull while 1.9% felt that practical work is much more a series of restrictive exercises. On the other hand very high percentages of 96.0%, 88.0%,

45.0% and 22.0% disagreed with the assertion that practical is closed, convergent and dull, it is much work a sense of restrictive exercises it has very little to do with scientific activities and assumes that scientific knowledge is subjective detached respectively. however, a study by SCORE (2007) identified lack of computers, lack of support from administration, student behaviour, content of the curriculum health and safety, lack of resources, culture belief and practices, negative attitudes and the inability to improvise apparatus are some of the weakness of practical work in secondary schools among others.

According to Kasada (2008) the weakness of physics practical work include lack of content among the teachers, insufficient teaching resources and financial support. According to Woolnough and Allsops (1980), practical work in the majority of the schools is closed convergent and dull. According to Lunetta (1981) students are rarely given the opportunity to formulate hypothesis and design experiments.

4.5.8. The female students' perceptions of the barriers to effective practical work in Physics

In this subsection, the Female Perception of barriers to effective practical work in Physics were collected and recorded in Table 4.24.

Table 4.24 The female students' perceptions of barriers to effective of practical work

Barriers to effective Practical work			
Male Perceptions	Yes-f(%)	No- f(%)	Total
A. Too many students in practical work	04(06%)	65(94%)	69 (100%)
B. Inappropriate assessment of practical work	50(72%)	19(28%)	69 (100%)
C. Insufficient funding being. Allocated to science department	20(29%)	49(71%)	69(100%)
D. Under-resource and old fashioned laboratories	06(09%)	63(91%)	69(100%)

The data presented in table 4.24 above shows that 98.0% of the female strongly agree with the assertion that practical work gets insufficient funding from schools while 2.0% of the responses didn't agree that insufficient funding is a barrier to effective practical work. Another 96.4% of the females thought that too many students in practical classes is big barriers to effective practical work. The higher percentage of 73.0% and 54.9% indicate that practical work is assessed inappropriately and is under-resourced in secondary schools respectively. 45.1% of the responses in the NO

category dismiss the argument that practical work is under-resourced, 27.0% did not believe product work is assessed inappropriately, 3.9% dismissed the idea of too many students in practical class and 2.0% back insufficient funding is really barrier to effective practical work. However, a study conducted in the Institute of Physics and tabled in the House of Lords (2006) there are five barriers to effective practical work, too many students in practical classes, inappropriate assessment of practical work, insufficient funding, under-resourcing and lack of confidence in the teaching of physics.

According to Thair and Treagurt (1999) some of the barriers to effective practical work include: low maintenance standards of laboratory facilities, lack of laboratory assistants and long time taken by teachers preparing the learning activities.

According to Cook and Taylor (1994) lack of teacher's knowledge skills and confidence restricts the amount of practical work that can be performed. According to UNICEF (2010) barriers to effective teaching of practical work can be categorist into physical, emotional and interactive barriers. Physical barriers include the sitting arrangement of the students, classroom space, good teaching and learning resources and adequate furniture. Emotional barriers may be caused by psychological changes and situations in the home or society. The interactive barriers arise from intimidative methodologies used by teachers which may undermine sexual and cultural backgrounds or abilities of learners, making them feel inferior and lowering their self-esteem.

4.6. The Male students' perceptions of practical work in Physics

This section is designed to address the fourth objective of this study that seeks to investigate the male student's perceptions of the importance and challenges of physics practical work in secondary school.

This section consists of eight sub-sections:- Sub-section 4.6.1. presents, interprets and discusses the male perceptions of the meaning of practical work in Physics. Sub section 4.6.2. Presents, interprets and discusses the male perception of the requirements of practical work. Sub section 4.6.3. Presents, interprets and discusses the male perceptions of the reasons for doing practical work. Sub-section 4.6.4.

Presents, interprets and discusses the male perceptions of the functions of practical work. Sub section 4.6.5. Presents, interprets and discusses the male perceptions of the significance of practical work. Sub section 4.6.6. Presents, interprets and discusses the male perceptions of the impact of practical work in Physics. Sub section 4.6.7. Presents, interprets and discusses the male perceptions of the weaknesses of practical work. The last Sub section 4.6.8. Presents, interprets and discusses the perceptions of the male on the barriers to effective practical work in Physics.

4.6.1. The male students' perceptions of the meaning of practical work

In this subsection, the Male Perception of meaning practical work in Physics were collected and recorded in Table 4.25.

Table 4.25 The male students' perceptions of the meaning of practical work

Meaning	Male Perceptions		
	Yes-f(%)	No- f(%)	Total
E. Practical work in Physics is a series of exercises.	04(06%)	65(94%)	69 (100%)
F. Practical work in Physics is a series of investigations.	50(72%)	19(28%)	69 (100%)
G. Practical work in Physics is a series of experiments.	20(29%)	49(71%)	69(100%)
H. Practical work is a series of tasks.	06(09%)	63(91%)	69(100%)

The data presented in table 4.25 above shows that 72.0% of the male students' responses in the YES category thought that practical work in Physics is mainly a series of investigations. About 20.0% of the respondents believed that practical work is a series of experiments while 9.0% held the opinion that practical work as a series of tasks and a small percentage (6.0%) thought that practical work is mainly a series of exercises. The responses in the NO category showed that 94.0% of the males did not consider practical work to be majorly a series of exercises, while 91.0% doubted whether practical work could be a series of tasks. The remaining responses, 71.0% believed that practical work could be a series of experiments only while another

28.0% dismissed the assertion that practical work could be majorly a series of experiments. However, as explained earlier, a similar study conducted in the United Kingdom in 2007 showed that practical work has variety of meanings, many of which are frequently used with little clarification. However, SCORE (2007) considers practical work as an interaction with materials to observe and understand the natural world. It is however, the view of this study that this definition acts as a starting point for clarifying practical working science education in the days to come.

According to Hudson (1990) practical work is a series of tasks in which students observe and manipulate real objects or materials for themselves. According to Lunette (2007) in his review of practical work, defines as learning experiences in which students interact with materials or with secondary sources of data to observe and understand the natural world.

According to Miller and Tiberglen (1998) the term practical work is used to refer to laboratory activities that include lectures, group experiments and teacher demonstrations where the learners are involved in handling and observing real object and materials.

4.6.2. The male students' perceptions of the requirements of practical work in Physics

In this subsection, the Male Perception of the requirements of practical in Physics were collected and recorded in Table 4.26.

Table 4.26. Males students' perception of the requirements of practical work in physics

Requirements	Male Perceptions		
	Yes-f(%)	No- f(%)	Total
A. Practical work in Physics			
Requires adequate apparatus.	13(19%)	56(81%)	69(100%)
B. Practical work in Physics requires			
careful preparation before hand .	20(29%)	49(71%)	69(100%)
C. Practical work in Physics requires			
Good organization throughout.	38(55%)	31(45%)	69(100%)
D. Practical work requires well			
trained teachers.	09(13%)	60(87%)	69(100%)

The data presented in table 4.26 above shows that 55.0% of the male students responses in the YES category believed that a good practical work requires good organization throughout. Another 29.0% of the responses thought that practical work in physics requires careful preparation before hand while 19.0% were convinced that practical work requires adequate apparatus and small percentage 13.0% of the males considered practical work required well trained teachers. A closer look at the data

shows that 87.0% of the males dismissed the argument that practical work requires well trained teachers while 81.0% did not believe that practical work requires adequate apparatus and 71.0% doubted whether practical work really requires careful preparation before hand. A smaller percentage of 45.0% of the males' responses in the NO category were not quite sure whether practical work requires good organization throughout. However, in a comprehensive publication by SCORE (2008) the requirements for a successful practical work is adequate apparatus, careful preparation before hand, good organization and well trained team of teachers. It is the opinion of the researcher in this study that this method of teaching can be improved by conducting more study on physics practical work.

According to Ferrant (1964), practical work requires careful preparation and organization before hand and provides profitable and emotionally satisfying activities. According to Twoli (2006) a good practical activity requires concise statement of objectives to guide the students focus into explain procedures for guiding the acquisition of objectives, schematic illustration of apparatus, data entry facilities and reportage of discussion and interpretation of the findings. According to Boz and Boz (2008) a teacher of physics should be equipped into adequate subject matter to be able to teach a discipline.

According to Gilbert and Josh (2005) it is important to use a variety of metals and instruments in order to gain a better understanding of the reality within science education.

4.6.3. The male students' perceptions of the reasons for doing practical work in Physics

In this subsection, the Male Perception of the requirements of practical in Physics were collected and recorded in Table 4.27.

Table 4.27. Male students' perception of the reasons for doing practical work in physics

Reasons for practical work	Male Perceptions		
	Yes-f(%)	No- f(%)	Total
A. To enable students acquire a feel of phenomena they are studying.	22(32%)	47(68%)	69(100%)
B. To prepare students for K.C.S.E. Practical examinations.	06(09%)	63(91%)	69(100%)
C. To develop in the students the Habit of working as a scientist.	19(28%)	40(72%)	69(100%)
D. Develop a range of practical skills And techniques.	33(48%)	36(52%)	69(100%)

The data presented in table 4.27 above shows that 48.0% of the male responses in the YES category indicated that the reasons for doing practical skills is to help students develop a range of practical skills and techniques, while 32.0% of them believed that practical work helps the students to acquire a feel of phenomena they are studying. In the same category 28.0% of the male responses support the assertion that practical work is used to help the student develop the habit of working as scientists, while

smaller percentage of 9.0% thought that practical work is done to prepare students prepare for Kenya Certificate of Secondary Education physics paper 232/3. However, the same data shows that 91.0% of the responses in the NO category don't think that doing practical work in schools must necessarily prepare students for KCSE examination only. While 72.0% of the responses in the NO category show that some of the male students are not quite sure whether practical work is administered to help student develop the habit of working as scientists. In the same NO category, 68.0% of the male students didn't think practical work enables students to acquire a feel of phenomena they are studying while 52.0% of the sample does not think practical work helps students develop a range of practical skills and techniques. In an article written by Mark Sinclair (1973) and published by Thomas Nelson and Sons Ltd are to help students learn how to record observations accurately and make accurate deductions.

According to the ministry of education science and technology (1973) the main reasons for doing practical work in science are to encourage careful observation and accurate recording, to develop various manipulation skills, to arouse and maintain interest and an attitude of curiosity.

In addition, practical work usual serves to teach proper use of control and the presentation of data and finally to verify scientific facts and principles already taught.

According to Shulman and Tanir (1973) the reasons for doing practical work are to arouse and maintain interest, attitudes, satisfaction, open mindedness and curiosity in science, develop creative thinking and problem solving abilities. In addition practical work is used to promote certain aspects of scientific thinking and the scientific method. Lastly, practical work is used in science to develop conceptual intellectual and practical abilities such as designing and executing investigations.

According to SCORE (2009) practical work in science is a hands on learning experience which prompts thinking about the world in which we live.

4.6.4. The male students' perceptions of the functions of practical work in Physics

In this subsection, the Male Perception of the requirements of practical in Physics were collected and recorded in Table 4.28.

Table 4.28. Male students' perception of the functions of practical work in Physics

Function for practical work	Male Perceptions		
	Yes-f(%)	No- f(%)	Total
A. It demonstrates theoretical ideas	50(72%)	19(28%)	69(100%)
B. It provides familiarities with the Apparatus.	03(04%)	66(96%)	69(100%)
C. It provides training on how to do Experiments.	17(25%)	52(75%)	69(100%)
D. It trains students how to use instruments	10 (15%)	59(55%)	69(100%)

The data presented in table 4.28 above shows that 72.0% of the male students believed that practical work is used to demonstrate theoretical ideas while 25.0% of them of held the opinion the practical work provides training on how to do experiments. A closer scrutiny of the data in the YES category indicates that 15.0% of the male responses believed that practical work trains students how to use instruments and 4.0% of them argued that practical work familiarizes the students with the

apparatus. The data in the NO category show that 96.0% of the responses don't believe that practical work familiarizes students with apparatus while 75.0% of the responses do not think that practical work trains students on how to do experiments. Another larger percentage of 85.0% of the male students dismissed the assertion of 28.0% of the responses indicated that practical work in physics is used to demonstrate theoretical ideas. However according to Justin Dhillon (2008) of Kings College London the functions of practical work in physics are to encourage accurate observations, to make phenomena more real, to arouse and maintain interest and to promote logical methods of thinking. The information in this table suggests that the majority of males 50(72%) hold the opinion that practical work is used to demonstrate theoretical ideas.

According to Hudson (1990) practical work in the teaching of science stimulates interest and enjoyment, teacher's laboratory skills of observation and measurement and enhances the teaching of scientific attitudes such as open mindedness, objectivity and willingness to suspend judgement. The programme designed by ASE (2009) to support teachers, technicians and teaching assistants in improving the effectiveness of practical work is believed to support skills development, experienced learning independent learning and development of thinking skills.

According to Benatte (2005), the functions of practical work in the teaching and learning of physics are to encourage accurate observations, to make scientific phenomena more real, to enhance the understanding of scientific ideas, to arouse and maintain interest particularly in young students and to promote a scientific method of thought. In view of the findings above this study concurs with the findings of Dhillon and advises further study in this area.

4.6.5. The male students' perceptions of significance of practical work in Physics

In this subsection, the Male Perception of the requirements of practical in Physics were collected and recorded in Table 4.29.

Table 4.29. Male students' perception of the significance of practical work in Physics

Importance of practical work	Male Perceptions		
	Yes-f(%)	No- f(%)	Total
A. It enables students to do physics rather than merely learning it	31(45%)	38(55%)	69(100%)
B. It in calculates the measuring skills in physics.	18(26%)	51(74%)	69(100%)
C. It prepares students for practical examinations.	22(32%)	47(68%)	69(100%)
D. It improves the skill of observing nature with alertness	09(13%)	60(87%)	69(100%)

The data presented in the table 4.29 above shows that 45.0% of the responses in the YES category were of the opinion that practical work enables students to do physics rather than merely learning about it, while 32.0% of the males think practiced with prepares students for practical examinations. In the same YES category 26.0% of the male students believed that practical work inculcates measuring skills while 13.0% of the male students believed that practical work improves the skill of observing nature

with alertness. On the other hand 87.0% of the male responses in the NO category didn't believe that practical work improves the skill of observing nature with the alertness while 74.0% of the male students dismissed the assertions that practical work inculcates measuring skills in physics. Similarly 68.0% of the male students do not agree with the argument that practical work prepares students for practical examination. While 55.0% of the male students dismissed the use of practical work to learn physics for reasons not very clear. However, Tsuma (2006) in a similar study reports that practical work in physics provides a means of obtaining (2006) in similar study reports that practical work in physics provides a means of obtaining facts about natural phenomena and also enable students to do science rather than merely learning about it. He adds that practical work is used to reinforce theory.

In yet another study conducted by Tamarrand (1981) and confirmed by Woolnough (1991) practical work helps the learners develop their investigative skills through their results of experimentation. According to Woolnough practical work provides numerous experiences, in which the student's manipulative materials gather data, make references and communicate their results in a variety of ways.

4.6.6. The male students' perceptions of the impact of practical work in Physics

In this subsection, the Male Perception of the impact of practical work in Physics were collected and recorded in Table 4.30.

Table 4. 30. Male perception of the of the impact of practical work in Physics

Impact of practical work	Males Perceptions		
	Yes-f(%)	No- f(%)	Total
A. It sharpens students skill in reading and writing	05(07%)	64(93%)	69(100%)
B. It help students to learn to think independently.	21(30%)	48(70%)	69(100%)
C. It provides the opportunity for students to handle instruments	12(17%)	57(83%)	69(100%)
D. It familiarizes student with proper Methods of observation and experimentation	42(61%)	27(39%)	69(100%)

The data presented in table 4.30 above shows that 6.10% of the responses in the YES category indicates that practical work familiarizes the students proper methods of observation and experimentation while another 30.0% were of the view that practical work help students to learn to think independently and another 17.0% of the male students believed that practical work provides the opportunity for them to handle instruments in physics. The least 7.0% believed that practical work sharpens the students ability to read and write. However a large percentage (93.0%) of the male students dismissed the assertion that practical work sharpens the reading and writing

skills while another 83.0% of the male students held the view that practical work does not necessarily provides the opportunity for students to handle instruments.

Similarly 70.0% of the male responses in the NO category disagreed with the argument independently while at the same time another methods of observation and experimentation. In a similar study reported by NESTA (2005) practical work has a positive impact in the student performance and attainment and that practical work increases student sense of ownership of the learning process and can be increase their motivation.

I another study conducted earlier by Kerr (1963) in England and Wales, the value of practical work include motivation, support for theory, development of skills and acquiring scientific approach.

According to Gott and Duggan (2003), practical work is viewed as the teaching and learning approach that develops procedural and substantive understanding a. It allows learning by doing and is an implicit experience of own productivity and provides opportunities for significant learning.

According to Millar (2004) effective practical work enables students to build a bridge between what they can see and handle and scientific ideas that account for their observations. Currently the Association for Science Education (ASE) is leading a new programme of professional development called “Getting practical” designed to support teacher’s technicians and teaching assistants in improving the effectiveness of physics practical work through using teaching and managing practical activities to meet particular aims.

4.6.7. Male perception of the of the weaknesses of practical work in Physics

In this subsection, the Male Perception of the impact of practical work in Physics were collected and recorded in Table 4.31.

Table 4.31. Male perception of the weaknesses of practical work in Physics

Weakness of practical work in physics	Male Perceptions		
	Yes f(%)	No. f(%)	Total
A. It is closed, convergent and Dull	05 (7.3%)	64(92.7%)	69(100%)
B. It assumes that scientific knowledge is subjective and detached	21(30.4%)	48(69.6%)	69(100%)
C. It is much more a series of Restrictive exercises.	12(17.4%)	57(82.6%)	69(100%)
D. It has very little to do scientific activities	42(60.9%)	27(39.1%)	69(100%)

The data presented in table 4.31 above shows that 60.9% of the responses in the YES category believed that practical work has very little to do with scientific activities where another 30.4% agrees with the assertion that practical work assumes that scientific knowledge is subjective and detached. Similarly, 17.4% of the male students held the opinion that practical work is much more a series of restrictive exercises while a small percentage (7.3%) of them didn't believe that practical work is closed. convergent and dull. A look at the responses in the NO category reveals that (92.7%) the male students did not believe that practical work is closed convergent and dull

while (82.6%) of them dismissed the argument that practical work is much more a series of restrictive exercises. In addition (69.6%) of the male students thought that practical work assumes that scientific knowledge is subjective and detached while 39.1% of them believed that practical work has very little to do with scientific activities. In a similar study conducted in United Kingdom by SCORE (2007), lack of support from school administration, student behavior, curriculum content, lack of resources and facilities, cultural belief and practices, negative attitudes and the inability to improve apparatus and lack of apparatus were identified as some of the weaknesses of practical work in physics.

Another 30.4% of males hold the opinion that practical work is subjective and detached from science. A smaller percentage of the males (7.3%) believe that practical work is closed convergent and dull. This implies that like females, males also believe that practical work has to be redesigned to be open ended, objective and related to theory.

According to Woolnough and Allsops (1980) practical work in the majority of Kenyan Secondary School is reported to be closed convergent and dull.

According to Kasada (2008), physics teachers lack of content features as the main reasons for poor content of knowledge of physics at Secondary school level. According to Kasada emphasis in the teaching of physics is on how to teach physics rather than on what to teach. In view of the findings of this study most of the male students believed that practical work has very little to do scientific activities contrary to the reports given by Woolnough, Allsops and Kasanda.

4.6.8. Male perception of the of the barriers of practical work in Physics

In this subsection, the Male Perception of the impact of practical work in Physics were collected and recorded in Table 4.32.

Table 4.32. Male perception of the of the barriers of practical work in Physics

Barriers to effective practical work	Male Perceptions		Total
	Yes f(%)	No. f(%)	
A. Too many students in practical class and associated behaviour problem	64(97%)	5(37%)	69(100%)
B. In appropriate assessment of practical work	48(70%)	21(30%)	69(100%)
C. Insufficient funding being devolved to Science department	57(82.6%)	12(17.4%)	69(100%)
D. Under resourced and old fashioned laboratories	42(60.9%)	27(39.1%)	69(100%)

The data presented in table 4.32 above shows that 97%) of the male responses thought that the crowding of student in classrooms makes it difficult to administer practical work. Another 82.6% of the response held the opinion that insufficient funding of science department makes practical work ineffective. In addition 70.0% of the responses in the YES category felt strongly that inappropriate assessment of practical work was a major barrier to proper use if practical work while 60.9% of the YES responses were strongly convinced that another barrier to effective practical work is the under-resourcing of same department and the use of old fashioned laboratories.

The responses in the NO category indicate that 39.1% of the male students dismissed under-resourcing at use of old fashioned laboratories as barriers to effective practical work while another 37.0% consider the crowding of students in practical class as a major reason for unproductive practical lessons. In addition 30.0% of the male student considered inappropriate assessment methods are a big challenge and another 17.4% of the male students considered insufficient funding as a major barrier to effective practical work in science related courses. As mentioned earlier, a similar study conducted by Institute of physics in the United Kingdom identified five barriers to effective practical work as too many students in practical classrooms inappropriate assessment methods of practical, insufficient funding by Government and schools, under-resourcing and the use of old fashioned laboratories and teachers who are not confident enough to teach physics in secondary schools.

According to Wilkinson (1997) some of the barriers to effective practical work are poor conditions, insufficient equipment and long preparation time. This therefore means that practical work consumes too much time and hinders the teachers from fulfilling the requirements of the science curriculum within anticipated time limits.

According to Thair and Treagist (1999) some of the barriers to effective practical work are among other low maintenance standards of the laboratory facilities lack of laboratory assistants requiring the teachers to spend long period preparing experiments. According to Cook and Taylor (1994) many of the physics teachers lack the knowledge skills and confidence that restricts the amount of practical work that can be performed by the students.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter consist of four sections:- Section 5.2 is a summary of the major findings of the study. In section 5.3 the conclusion drawn from the findings of the study are highlighted. In section 5.4 the researcher has made a recommendation to be considered.

5.2 Summary of the Major Findings

The study established that students, teachers, girls and boys have some challenges with the meaning of practical work, requirements of practical work, reasons for doing practical work, fuctions of practical work, significance of practical work, effectiveness of practical work, the weaknesses of practical work and the barriers to effective practical work.

The analysis of students perceptions about physics practical work reveal that the majority of the secondary school students believe that practical work is a series of investigations, requires good organization, help students develop a range of practical skill6,familiarizes students with apparatus, enables students to do physics, familiarizes students with proper methods of observation and experimentation, assumes that scientific knowledge is subjective and detached from reality and is under resourced and old fashioned.

In the same breath the findings have shown that the majority of the teachers of physics like the students believe that practical work is a series of investigations, requires good organization, develops a range of practical skills and techniques, provides training on how to do experiments, enables students to do physics, familiarizes students with proper methods of observation and experimentation, is much more a series of restrictive exercises and receives insufficient funding from the government

Similarly the research findings have shown the majority of the female respondents believe that practical work is a series of investigations, practical work demonstrates theoretical ideas and provides opportunity for students to handle apparatus and instruments, in calculates the measuring skills in students, has very little to do with the scientific activities and receives insufficient funding from the government.

Finally the research findings have also shown that the majority of male respondents believe that practical work is a series of exercises it requires good organization, demonstrates theoretical ideas, improves the skills of observing nature with alertness, sharpens students skills in reading and writing, it has very little to do with scientific activities and is ineffective because of too many students in classes.

The fourth objective purposed to explore the male student perception of physics practical in secondary schools within Kakamega East Sub-county, Kakamega County. The findings have shown that male students view practical work as a series of investigations designed to demonstrate theory, and enable students to physics rather than merely learning it

According to the male students, practical work requires good organization throughout and helps the students develop a range of practical skills and techniques.

5.3 Conclusions

The study established Results gathered from the district have shown that the secondary school students and teachers share or hold the same perceptions on the nature and purposes of practical work in Physics.

Comparisons of the data collected over a period of two months indicated that at least there was no notable difference between the student's opinions and those of their teachers.

The reason for this observation can be explained by arguing that the student's perceptions are enforced by teacher's perceptions either negatively or positively. A student who is discouraged by the parent or society can still make it if teachers sustain positive perceptions towards him or her at school. It is therefore evident that the students' performance in any one subject is attributed to their teachers' encouragement. Teachers are therefore advised to look for ways they can improve their perceptions towards their students work. The majority of students and teachers questioned in this study shared the following perceptions:-

That practical work is a series of experiences that require good organization throughout. In addition, many students and teachers felt that most of the practical work in physics be in form of class experiments in accordance with the principle of student- centered teaching. Similarly, practical work was described stimulating by many of the students and that is majorly used to elucidate theory.

However the growing body of research evidence suggests that teaching theory through practical work is not an efficient way of transmitting and understanding of

scientific concepts. Although practical work is believed to create permanent impressions in the minds of the learners it is unfortunate that the majority of those questioned suggest that it be reserved for the less bright boys and girls. In their view the present practice in our secondary schools portrays practical work as a series of restrictive exercise.

In some of the perceptions gathered in the study, the students were of the opinion that practical work in physics could be improved by focusing the learners' attention on desired learning outcomes while the majority of the teachers were of the opinion that practical work could be improved by utilizing curiosity and encouraging its development. Both students and teachers agree that practical work serves to demonstrate theoretical ideas, verify scientific facts and principles, learning by doing, developing scientific concepts and principles, enables children to do science rather than merely learning about it and preparing students for practical examinations.

Lastly, practical work familiarizes students with proper methods of observation and experimentation, arouses and maintains interest and the perceptions of curiosity especially when the students perform the experiments themselves rather than the teacher and trains the students to analyze results of the experiments.

5.4 Recommendations

In an effort to improve the performance in practical work in physics the researcher makes the following recommendations:- Teachers and technician guides must be produces to enhance the teaching and learning process in schools. It is also recommended that there has to be a continuous research in education. In addition the benefits of practical work in physics have to be maximized. It is also advisable to improve information flow about good practical science. It also advisable to improve the quality of practical work administered in our schools. The researcher also advices the school to equip the science laboratories with modern facilities. It is advice that the use ICT in teaching and learning process should supplement and not replace hand on activities.

The findings of this study are vital to the Ministry of Education, other policy makers and implementers in improving the performance of physics practical in secondary schools. In addition, this study has made contribution to the existing body of knowledge in the wider field of science education for it has provided a platform for further research.

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APPENDIX A- KINDS OF PRACTICAL WORK

This appendix contains more information on secondary school students and teachers perceptions on the nature and purpose of practical work in Physics.

NO.	KIND OF PRACTICAL WORK	DESCRIPTION	EXAMPLES
1	Practical exercises	These are tasks designed to develop scientific practical skills of observation and measurement and manipulation of equipment	Setting up simple electrical circuits Using scientific equipment
2.	Investigations	These are tasks designed to give students practice and opportunity to develop competence.	Investigating ways of harnessing wind or water power. Investigating the size of an image formed in a pin hole camera.
3.	Practical experiences	These are tasks designed to give students a feel of phenomena	Growing of crystals Stretching of a spiral spring

APPENDIX B- RESEARCH QUESTIONNAIRE USED IN THE STUDY.S

SECTION A- PERSONAL DETAILS OF RESPONDENTS

Answer all the question in this section. For each question circle the letter next to the response that is most like you.

1. Gender

- A. Male student
- B. Female student
- C. Male teacher
- D. Female teacher

2. Age

- A. Under sixteen-16
- B. Between 16-21 years
- C. Between 22-35 years
- D. Over 35 years

3. Our school is

- A. Boys boarding
- B. Girls boarding
- C. Mixed boarding
- D. Mixed day

SECTION B- INSTITUTIONAL DETAILS

1. How many physics teachers does the school have?
 - A. None
 - B. One
 - C. Two
 - D. More than two

2. How many laboratories are in the school?
 - A. None
 - B. One
 - C. Two
 - D. More than two

3. How many laboratory assistants does the school have?
 - A. None
 - B. One
 - C. Two
 - D. More than two

4. How often do you do practical work in physics?
 - A. Not at all
 - B. Once a week
 - C. Twice a week
 - D. Daily

5. How many of the Form Threes are taking physics?
 - A. Less than ten-10
 - B. Between 10-20
 - C. Between 20-40
 - D. Over than 40

**SECTION C – PERCEPTIONS ON THE NATURE OF PRACTICAL WORK
IN PHYSICS**

Answer all the question in this section. For each question circle the letter next to the response that is most like you.

Remember there are no wrong answers.

1. The term “Practical work” in physics is used to refer to
 - A. A series of exercises
 - B. A series of investigation
 - C. A series of experiences
 - D. A series of tasks

2. Any successful practical work in physics requires
 - A. Adequate apparatus
 - B. Careful preparation beforehand
 - C. Good organization throughout
 - D. Well trained teachers

3. In my opinion practical work is good for
 - A. Boys
 - B. Girls
 - C. The bright boys and girls
 - D. The less bright

4. Which of the following statement describes the weakness of practical work in physics?
 - A. It is closed, convergent and dull
 - B. It assumes that scientific knowledge is objective and detached
 - C. It is much more a series of restrictive exercises
 - D. It has very little to do with scientific activity.

**SECTION D- PERCEPTIONS ON THE PURPOSE OF PRACTICAL WORK
IN PHYSICS**

Answer all the question in this section. For each question circle the letter next to the response that is most like you.

1. Practical work in physics serves
 - A. To demonstrate theoretical ideas
 - B. To provide familiarity with apparatus
 - C. To provide training in how to do experiments.
 - D. To train students to use instruments

2. Which of the following will be true about practical work in secondary schools?
 - A. It enables students to do science rather than merely learning about it.
 - B. It inculcates the necessary skills in science
 - C. It prepares students for practical examinations.
 - D. It involves observing nature with alertness.

3. Below are four possible purposes of practical work in physics. Which one is most like you?
 - A. To enable students acquire a feel for phenomena they are studying
 - B. To prepare students for KCSE
 - C. To develop in the student the habit of working as scientist.
 - D. To develop a range of practical skills and techniques

4. What do the majority of your schoolmates say about practical work in physics?
 - A. It sharpens student's skills in reading and writing
 - B. It helps the students to learn to think independently
 - C. It provides the opportunity for the student to handle instruments.
 - D. To familiarize students with proper methods of observation and experimentation.

APPENDIX C

LIST OF SCHOOL VISITED IN KAKAMEGA EAST SUBCOUNTY

1. Mukumu Girls High School
2. Mukumu Boys High School
3. Mukhonje Secondary School
4. St. Josephs' Malimili Sec. School
5. Museno Secondary school
6. Shanjero Secondary School
7. St. Agnes Shibuye Girls
8. Lirhanda Girls Secondary School
9. Lwanda Secondary School
10. Handidi Secondary school
11. Bukhaywa Secondary School
12. Shanderema Secondary School
13. St. Philip's Girls Secondary School – Mugomari
14. Mukhuru Secondary School
15. Shabwali Secondary School

APPENDIX E- RESEARCH AUTHORISATION PERMIT



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P.O. Box 30623-00100
NAIROBI-KENYA

Ref: No. **NACOSTI/P/16/79094/9925**

Date:
11th April, 2016

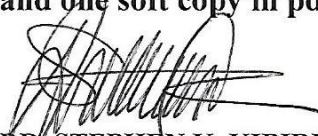
Ackab Lisamula Masingu
Masinde Muliro University of
Science and Technology
P.O. Box 190-50100
KAKAMEGA.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on “*Students and teachers perceptions of physics practical work in secondary schools in Kakamega East Sub - County, Kenya,*” I am pleased to inform you that you have been authorized to undertake research in **Kakamega County** for the period ending **4th April, 2017.**

You are advised to report to **the County Commissioner and the County Director of Education, Kakamega County** before embarking on the research project.

On completion of the research, you are expected to submit **two hard copies and one soft copy in pdf** of the research report/thesis to our office.


DR. STEPHEN K. KIBIRU, PhD.
FOR: DIRECTOR-GENERAL/CEO

Copy to:

The County Commissioner
Kakamega County.

The County Director of Education
Kakamega County.