INFLUENCE OF PRACTICAL WORK ON THE MASTERY OF THE BIOLOGY SUBJECT IN PUBLIC SECONDARY SCHOOLS, IN DAGORETTI SUB – COUNTY, NAIROBI COUNTY

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A Constituent College of the Catholic University of Eastern Africa

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DECLARATION

This research project is my original work and has not been presented for any academic credit in any other University.

…….. **……**

Yao Aristide Ghislain **Date**

This Research Project has been submitted for examination with my approval as the University College Supervisor.

…… **……**

Mr Mwangi Frederick **Date**

The Research Project has been accepted by the Head of Department of Education

……. **……..**

Dr Everlyn Suleh **Date**

DEDICATION

I hereby dedicate this project to my biological and religious families, friends and teachers and the Marist District of West Africa

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABRREVIATIONS AND ACRONYMS

MIC - Marist International Center

MIUC - Marist International University College

KCSE - Kenya Certificate of Secondary Education

KNEC - Kenya National Examination Council

NESTA - National Endowment for Sciences, Technology and the Arts

OFSTED - Office for Standards in Education

SPSS - Statistical Package for Social Sciences

UNESCO - United Nations Educational Scientific and Cultural Organization

ABSTRACT

This study analyzed the influence of practical work on the mastery of Biology subject in public secondary schools in Dagoreti Sub-Country, Nairobi County. The study was based on three objectives specifically; To find out whether the attitude of the learners towards practical work contributes to the mastery of Biology Subject, to investigate how the attitude of teachers towards Biology practical work influences mastery of Biology Subject, to investigate whether practical work contributes in improving students' interest towards Biology. This research adopted the quantitative research paradigm particularly the cross-sectional survey method in obtaining quantitative data. 87 students and 11 teachers were randomly sampled from three schools in Dagoretti Sub-county. Data was collected through administration of questionnaires to the respondents and were analyzed by means of the SPSS lay out and presented using frequency tables, bar charts and percentages. The findings of this study disclosed that practical work has a considerable influence on the mastery of the Biology subject. It showed that students and teachers generally have a positive attitude toward biology yet students fail sometimes to decipher the relationship between theory and practical. The study further disclosed that laboratories were available in schools but were not used adequately, furthermore the time allocated for practical lessons was enough yet the respondents demanded for more time and finally in as much as skills are emphasized in practical lessons, the research unveiled that teachers tended to emphasize more on basic process skills over integrate process skills. This study will offer a framework in which teachers could re-evaluate their instructional strategies during practical work for the enhancement of effective teaching and learning.

To achieve this teachers need to make the students more aware of the roles theory and practical play as part of a whole in the biology syllabus, more laboratories need to be built in schools and adequate time allocated for practical

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Laboratory practical is the teaching and learning activity of any science which involves students, working individually or in small groups, manipulating and/or observing real and unreal objects and materials, as opposed to the virtual world. Laboratory method is the most effective teaching technic and it is effective in helping students construct their knowledge, develop logical and inquiry type of skills and develop cognitive, affective and psychomotor skills. Laboratory work also has great potential in promoting positive attitudes and providing students with opportunities to acquire skills regarding cooperation and communication (Hofstein, 2004 a).

Teaching and learning are by their very nature an active process. Hence they should involve the full participation of the students both in mind and in body in order to enhance the acquisition of knowledge and development of problem solving techniques. Through this sort of participation, students become responsible for their own learning and thus the extent to which the students learn depend on how they participate in such lessons. The more students learn through hands-on, the more they discover new things and assimilate more difficult concepts especially in Biology lessons which to a greater extent need more practical activity.

It is often argued that practical work is central to mastery of science subjects and that good quality practical work helps develop pupils' understanding of scientific processes and concepts. However, there are, and have been for some time, concerns about practical work in secondary school science.

Practical work carried out by students themselves is an essential part of science education although critical views on its effectiveness do not really exist. Many science educators and science education researchers believe that student practical work leads to better science learning. Hofstein, A. & Lunetta, V. N. (2005 a) for example, state that "laboratory experiences have been purported to promote central science education goals, including the enhancement of students' abilities; scientific practical skills and problem solving abilities; scientific 'habits of mind'; understanding of how science and scientists work; interest and motivation" (p.40). Apart from helping students to gain insight into scientific knowledge, practical also help them to acquire a number of scientific skills, namely cognitive and manipulative, not to mention the motivational factors it creates in the students. The attainment of these goals however depends on the way practical work is organized and performed in schools.

Biology is one of the science subjects taught in secondary schools in Kenya alongside Chemistry, Physics and Mathematics. Twoli (as cited in Grace, 2009) asserts that for a student to be considered to have performed well in Biology he or she must, to a greater extent, have performed well in Biology practical work. Practical work in Biology is geared towards instilling and achieving certain skills in students such as:

- The aptitude to record observations accurately
- The ability to make accurate deductions
- The keenness to follow instructions and carry out experiments
- The capacity to make accurate observations that will lead to accurate conclusions

According to Grace (2009), the government of Kenya recognizes the importance of science in the realization of its vision 2030, so that she may become a globally competitive and prosperous country. This is reflected in the amount of resources, both human and otherwise, that are channeled into the teaching and learning of these science subjects at all levels of education. At the secondary school level, the government has implemented a number of intervention strategies to ensure that the teaching and learning of these science subjects are as effective as possible.

Kenya like other developing countries invests heavily in the teaching and learning of practical work in science and Biology in particular. However, this high input of resources does not seem to be reflected in the performance of students in Biology. There are concerns about the decline in the number of students continuing with science and Biology in particular. There is a strong relationship between students' attitudes towards practical and their performance. Following the studies, the researcher has reviewed there has been no research on the influence of practical work on the mastery of Biology subject especially in public secondary schools.

1.2 Statement of the Problem

According to Anidodoh (2001) in his study noted that a sound theoretical and practical knowledge of Biology is needed for the management of our natural resources, provision of good health facilities, adequate food supply and favorable life environment. Studies have been carried out in relation to practical work in science as a whole. Among these is a study carried out by Grace (2009) on factors influencing students' performance in science practical work in secondary schools in Nairobi division. The findings of this study revealed that students' performance in practical work in science is greatly influenced by the teachers' and students' attitude towards practical work and also by the organization of practical activities. Another study carried out by Hans Berinyuy (2016) stressed on the Influence of Practical Work on the Teaching and Learning of Chemistry in Public Secondary Schools, in Ngong Sub-County, Kajiado.

The afore mentioned studies have only mentioned students' performance in practical work and how to perform it but did not mention how practical activity influences the mastery of the Biology subject. It is for these reasons that the researcher wants to find out the influence of practical work on the mastery of Biology subject in public secondary schools in Dagoretti sub-County, Nairobi County.

1.3 Objectives of the study

1.3.1 General Objective

The main intent of this study was to determine the influence of practical work on the mastery of Biology Subject in public secondary schools in Dagoretti sub-county, Nairobi County.

1.3.2 Specific Objectives

To find out whether the attitude of the learners towards practical work contributes to the mastery of Biology Subject

I. To investigate how the attitude of teachers towards Biology practical work influences mastery of Biology Subject.
II. To investigate whether practical work contributes in improving students' interest towards Biology.

1.4 Scope and Delimitations of the Study

The study chose to three public secondary schools in Dagoretti sub-county, Nairobi County. This is because these schools chosen are all co-educational institutions. This in essence will help the findings of the research to be based on views of both genders. In addition, being public schools indicates that they embrace students from all over Kenya so to speak and therefore with a wider range of thinking and diversity of ideas which also adds flavor to the study. The study used from form three and four students because they have spent more years in schools and consequently are more deeply rooted into the school and the country's education system.

1.5 Significance of the Study

Since this study is aimed at investigating the influence of practical work on the mastery of Biology subject in public secondary schools, then it could:

Help teacher trainees in improving the teaching of Biology. This is because the study may help them in selecting appropriate strategies that could be put in place for the improvement of adequate preparation in pre-service and in-service training in Biology.

This study offers a framework on which teachers could re-evaluate their instructional strategies during practical work. All these will help to build students' attitude and confidence in practical work and maybe reinforce the importance of practical work to the mastery of Biology subject.

Help narrow down the type of practical activities that are necessary for secondary school students, so that in turn, they could provide pointers for the curriculum designers into the kind of practical experiences in secondary school Biology that is needed to aid sound understanding of scientific concepts and principles. This could also aid in the curbing down wastage of time and resources while at the same time maximizing teaching and learning of sciences and biology in particular.

Open up the minds of educational scholars to build up new theories as regards the role of practical work on the Biology subject. In as much as a lot has been covered on the different ways of teaching Biology, very few scholars have ventured into the influence of practical activities on the teaching and learning of students much less about how these affect students' performances in Biology. Thus the findings of this research may require scholars to delve more into this problem and maybe propose suitable remedies to researchers.

The findings of this study may also press on the government to pay more attention to the teaching and learning of sciences and Biology in particular in public secondary schools. By this the government may look hard into allocating more funds for sciences. This will enable the managers to provide up-to-date laboratory equipment and

facilities for their science students. By so doing the teachers and students may develop a more positive attitude towards practical work and consequently the teaching and learning of Biology may be improved.

1.6 Theoretical Framework

This study elaborated on the concept of human information coordinating behavior (HICB). According to this theory (as cited in Winber, 2006) in order for learning to be achieved then a favorable environment must be a requisite. Thus a learning environment should be fraught with a variety of variables such as attitude towards teaching and learning, learning resources, instructional strategies and even pre-requisite knowledge. A teaching and learning resource is something that can be used to simplify or clarify certain concepts or principles which would otherwise appear abstract (Twoli, 2006). Resources are important in the teaching-learning process because they do not only provide concrete experiences, but also help students to integrate prior experiences with new learning hence aid in understanding. This study probes into the influence of practical work on the mastery of Biology subject in public secondary schools in Dagoretti Sub-County, Nairobi County. In light of this the following will be looked at and analyzed: school factors, teacher factors and student factors as factors which influence the school environment and thus contribute to the acquisition of skills during practical work and consequently its influence on the mastery of Biology.

School factors will include: the school type which in this case is co-educational. They could also include availability of teaching and learning resources and/or materials, the laboratory hardware equipment such as laboratory apparatus and furthermore laboratory software such as chemicals and solutions used for practical activities. They will as well include the quality of experiments students carry out during the school year and also the kind of projects and tests they undertake as a means towards attaining mastery of Biology subject.

Teacher factors will include: teacher's attitudes towards teaching practical work, training, teaching experience and teaching style. These factors are likely to influence the way chemistry teachers choose, arrange and present activities in practical work in chemistry to students.

Secondary students' attitudes to practical work are, generally speaking, positive. However, the extent to which such attitudes to practical work differed, not only across the three sciences, but also showed a statistically significant decline as students progressed through their secondary school education. The reason for this being that the relative importance of the cognitive, affective and behavioral domains changed adversely as students moved away from a more practical way of studying to a more theoretical manner of leaning which was more examination orientated. Thus, student factors such as: attitude towards learning, entry behavior, learning styles and abilities are likely to be influenced by the way a teacher organizes and presents practical activities during practical work in Biology. If practical activities are presented well and scientific skills practiced to desired levels by students then there is a high possibility of enhancing the Biology subjects by the learners

1.7 Organization of the Study

This particular research is divided into five chapters. The first chapter highlights the preliminary steps in the research, it comprises of the background of the study, statement of the problem and the objectives which are to be met, limitation of the study and delimitation and the significance of the study.

The second chapter presents literature review or the account of the review of previously written and relevant material on this research. Chapter three deals with the research design, research methodology and the data collection process and the instruments for gathering data, followed by chapter four where data is analyzed and interpreted.

Finally, chapter five is a summary of the study, conclusion of the findings and recommendations and suggested areas of further study.

1.8 Operational Definition of Key Terms

Teaching: This is the process of transmitting knowledge, values, attitudes and skills from one person to another

Learning: This is the process of acquiring knowledge, values, attitudes and skills through experience, study, or by being taught. Learning leads to a permanent change in behavior as a result of experience.

Attitude: A way of thinking or feeling about something or somebody usually reflected in a person's behavior when s/he reacts toward or against some situation, person, or object in a particular manner.

Biology: *it* is a natural science concerned with the study of life and living organisms, including their structure, function, growth, evolution, distribution, identification and taxonomy.

Influencing: This is the ability to have the power to affect something in a given way.

Laboratory: A room used by students and teachers for the study of any branch of science for example chemistry through experimentation and observation.

Performance in Biology: The mean scores students obtain in KCSE chemistry examinations.

Practical work: Any teaching/learning activity devoted to the study of a particular subject for example chemistry through experimentation and observation.

Public schools: Schools that are formally supported by the government especially in terms of recruitment of teachers.

CHAPTER TWO

LITERATURE REVIEW

In this chapter, the researcher reviewed existing studies carried out by other researchers regarding Biology practical work/activities. The chapter is divided into the following areas: influence of learners' attitude towards practical work on the teaching and learning of Biology, the attitude of teachers towards teaching Biology practical work, the opinions of teachers and students towards the aims of Biology practical work, the contributions of practical work towards the improvement of students' interest in learning Biology, influence of the quality of laboratory materials on the learning of Biology practical and the effects of time allocated for practical work on the teaching and learning of Biology.

2.1 Influence of Learners' Attitude towards Practical Work on the Teaching and Learning of Biology

The emphasis for students during the theory component of teaching and learning biology is on the acquisition and processing of knowledge in the form of facts, concepts, and laws/principles. In most cases this theoretical aspect of biology presents students with concepts and principles that are abstract making it difficult for them to concretize. The use of practical work in teaching therefore is to help in making the theoretical aspect of biology more concrete and enjoyable for the students.

The attainment of these goals may however as observed by Gastel (2007) depend on the students' active participation in the laboratory work/experiments which is determined by proper use of laboratory tools such as equipment or apparatus, materials and chemicals and the

execution of correct procedural techniques. Effective participation can only be obtained if students practice the various scientific skills to desired levels safely in the laboratory guided by the teacher. This brings about a positive attitude in students towards practical work which in turn improves their performance in practical work and mastery of content.

Rachael (as cited in Prokot, Tuncer & Chudá, 2007) highlight the importance of understanding students' attitudes in order to positively affect their achievement and interest within a particular discipline. Thus, by researching into students' attitudes to practical work, there is hope to encourage teachers in supporting their students to achieve in their subject. One of the main issues as stressed by Toplis (2012) with previous studies has been the fact that the claims tend to be generic and go little further than reporting that practical work is seen as enjoyable. This shows that the attitude of students towards practical work is generally a positive one. This further explains that the more positive the attitude of students towards practical work, the more motivated they are to study and consequently the better their performance in practical activities.

2.2 Attitude of Teachers towards Teaching Biology Practical Work

Research on teacher effectiveness has progressed for many years yet most explicit measures of teacher qualifications such as experience and education has little effect on student achievement as Thompson and Soyibo (2001) express. In contrast, Twoli (2006) say that implicit measures of teacher qualifications such as the average performance of teachers differed significantly across teachers. These studies lacked controls for the prior achievements of the students attending different schools. If districts assigned teachers with stronger credentials to schools with better prepared students, then the estimated returns to teacher credentials could not be overstated.

The most recent literature on teacher qualification uses panel data to better cater for student heterogeneity and in some cases teacher heterogeneity. These modeling approaches link the current achievement level of students to family, teacher and school inputs provided in previous time periods (Grace, 2009). The methods examined the contribution of current education inputs (for example, a school reform or assignment to high quality teacher) on student outcomes. Ideally, model estimation requires a comprehensive history of all past and present family, teacher and school inputs as well as information about each student's ability. The information, however, leads to potential biases due to student unobserved heterogeneity caused by teachers' unobserved heterogeneity and non-random assignment of students to particular teachers. All evidence gear towards the fact that a teacher's qualification plays a vital role in the teaching and learning of science as a whole and Biology in particular.

Learners draw from teachers' dispositions to form their own attitudes, which may likely affect teaching and learning outcomes. Bandura (as cited in Grace, 2009) in his observational theory demonstrated that behaviors are acquired by watching another (the model, the teacher, the parent, mentor and even friend) that performs the behavior. The model displays the behavior and the learner imitates it. Teachers are role models whose behaviors are easily copied by students. There is a high likely chance that what a teacher likes or dislikes, or how they feel about their subject (especially in teaching) could have significant effect on the student. Unfortunately, most teachers do not realize this and tend to be careless in their teaching especially of practical work. Teachers' attitude towards their subject must be favorable enough to carry students along. When the learner exhibits the expected behavior, the value attached determines very significantly the effectiveness of the learning process in any aspect of education. Cheung (2009) also notes that for teaching and learning of science to be interesting and stimulating, there has to be motivation

on the part of both the teacher and the learner so as to ensure the development of a positive attitude and consequently a maximum academic achievement. Thus teachers' attitude either towards science and Biology in particular, affects students' achievement in and attitude towards the subject as well.

2.3 Opinions of Teachers and Students towards the aims of Biology Practical Work

In reviewing the aims and purposes of, or indeed reasons and justifications for, practical work, referring to the comment made by Solomon (1980, p. 40) can generally encapsulate most teachers' first thoughts; "Practical work is an important part of science as cooking is in the kitchen, but to what value is practical work as part of science education?" Since then, there have been many educational researchers who have produced categories of reasons for conducting practical work within science education, such as Shulman and Tamir (2008) who posit that students and teachers commonly agree that there are common aims to practical activities, such as; appeal to students, improvement of scientific skills and promoting the scientific culture. According to Shulman and Tamir (2008) practical work in Biology is meant:

- To arouse and maintain interest, attitude, satisfaction, open-mindedness and curiosity in science;
- To develop creative thinking and problem-solving ability;
- To promote aspects of scientific thinking and the scientific method (for example. formulating hypotheses and making assumptions);
- To develop conceptual understanding and intellectual ability;
- To develop practical abilities (for example. designing and executing investigations, observations, recording data, and analyzing and interpreting results).

- To foster knowledge of the human enterprise of science so as to enhance student intellectual and aesthetic understanding;
- To foster science inquiry skills that can transfer to other spheres of problem solving;
- To help the student appreciate and in part emulate the role of the scientist; and
- To help the student grow both in appreciation of the orderliness of scientific knowledge and also in understanding the tentative nature of scientific theories and models.

However, Hofstein and Lunetta (as cited in Gott & Duggan, 2005) suggested that the purposes, as stated above, were rather similar to the purposes for science as a whole and that distinct reasons for practical work were needed, especially at a time when there had been a shift from student-led work. This provided less time and experience in the science laboratory, primarily due to the need to meet examination requirements.

The conclusions here were that when suitable activities are used in laboratories then effective development and promotion of logic, inquiry and skills for problem-solving might occur. Although to what extent such skills and inquiry could be learnt just as effectively through other pedagogic methods and indeed in other subjects has yet to be raised.

The House of Lords Science and Technology Committee (2006) claim that there are three essential aims that are the principals of scientific activity, and justification for the use of practical work, these include:

a) Developing practical scientific skills and techniques;

b) Being a problem solving scientist; and

c) Getting a 'feel for phenomena'

Surprisingly, the aims they proposed did not include the motivational, stimulating and enjoyable aspects of practical work. However, there had been comments made before this time about the

use of practical work according to Grace (2009), to encourage and motivate students according to teacher opinion.

Woolnough and Allsop (2011) assert that it seemed the motivational aspect of practical work for students was far too restrictive and generally only favoured because the alternatives were presented in a negative way by teachers to students. According to Hodson (2007), this approach of using practical work as a means of behaviour control has been used by teachers in countries such as the United Kingdom as a strategy for dealing with mixed achieving classes. Due to this strategy, Hodson (2007, p. 288 b) further suggested three further aims as reasons for teachers doing practical work. The aims included, "to reward pupils for good behaviour; to allow students to work at their own pace; to add variety to classroom activities" Even though students may hold an interest and want to conduct practical work, it does not necessarily imply cognitive learning purely because the context of that learning has become seemingly more relevant to the student.

Just because students find doing practical work 'enjoyable' does not mean that students will be thinking or learning about what they are doing, rather the opportunity to have the freedom of something different in learning science. In such a case, a possible purpose to enhance scientific knowledge via practical work seems difficult to attain. This is especially true where doing is ineffective at enhancing students' understanding, or learning, of science. Twoli (2006) suggests five possible aims of the purpose and justification of practical work taken from teachers' responses. These are:

- To motivate, 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.

- To develop certain 'scientific attitudes', such as open-mindedness,
- Objectivity and willingness to suspend judgment.

However, after critical analysis of the above aims, Hodson (2007, p. 39), found that "theoretical arguments and research evidence have reinforced the view that practical work in school science – as presently organized – is largely unproductive and patently unable to justify the often extravagant claims made for it". Clackson and Wright (2009) drew a similar conclusion, although they suggested that there might be an argument for having practical work as a subject in its own right. The reasoning behind this was that the acquisition of skills was rather generic and thus not primarily concentrated within science education. The problem that many educational researchers had found was that due to the undefined nature of what and how best practical work should be conducted in schools, meant difficulties arose with pedagogy and learning. According to Abrahams and Miller (2008), the problem with understanding the true purpose of practical work within science education is still an issue. This unclear focus may lead to an array of different approaches of practical work in schools that potentially will influence the learning outcomes for the students.

2.4 Contributions of Practical Work towards the Improvement of Students' Interest in Learning Biology

Practical work is essential and irreplaceable because it is used when students are unlikely to have observed the intended phenomenon, or to have observed it in insufficient detail, in their everyday lives (Millar, 2004). The centrality of the laboratory to the teaching of science has become like the addicts' relationship to their drug – an unquestioned dependency which needs to be re-

examined and weakened if not broken altogether. It has been noted already that practical work has become a central plank - a defining feature of school science.

Orodho, A. J. (2009) promotes the value of cognitive conflict, meta-cognition and bridging from concepts to new situations and provide substantial evidence of the impact of cognitive acceleration through science education on science attainment. Her studies also point to the need for any innovation to be supported by classroom-focused coaching and modeling which involves at least 20-30 hours of professional development. Such approaches provide teachers with opportunities to engage students in activities which are minds on as well as hands-on. There is also some evidence to show that the experience of carrying out extended practical projects can provide students with insights into scientific practice and can increase interest in science and motivation to continue its study. Examples of the successful use of extended projects are, however, mainly at upper secondary school level or above, where students are to some extent self-selected, teachers have (in general) better subject knowledge, and group sizes are smaller.

With regards to attitudes to practical work, studies have found that teacher-pupil discussions in Oman and Northern Ireland indicated strongly that students in both countries preferred practical work in science to textbook learning. The study was primarily a research on students' attitudes to science at the primary school level but the findings that students tend to prefer practical work over other methods of teaching science has been noted (Abraham & Miller, 2008). Hodson (2007 c) reported on student and teacher attitudes to the purpose and effectiveness of practical work in science at the equivalent Year 10 level of secondary school in Australia. This study found that teachers' and students' attitudes about the importance of practical work were statistically different. Also, the school laboratories in Australia were under-resourced which meant that

teachers were unlikely to conduct practical work or see it as a highly effective means of learning science.

Many scientists and science educators are convinced that practical work must play an important role in learning science, but the reasons for its prominence are less clear. “This lack of clarity lies in the vagueness of the questions asked about the role of practical work. Asking about the effectiveness of practical work for learning is like asking whether children learn by reading. The answer lies in the nature and contents of the activities and the aims which they are trying to achieve” (Watson, 2007, p. 57)

In a recent survey carried out by the National Endowment for Science, Technology and Arts (NESTA, 2005 b) 99% of the sample of science teachers believed that enquiry learning had an impact on student performance and attainment. However, views about the role of processes in science education have been contested. Some science educators have argued that practical work might help students to understand how scientists work, while others have argued that a process-based approach (that is, an approach that focused on experimental skills) was likely to lead to better understanding of science concepts (Donnelly, 2007).

According to Lunetta, Hofstein and Clough (2007) “Students need to understand something about the nature of science if they are to appreciate the limits and value of practical activities thus the teachers’ role in helping students to compare their findings with those of their peers and with the wider science community is critical” (p. 405)

2.5 Influence of the Quality of Laboratory Materials on the Learning of Biology Practical

It is generally the case that it is teachers that control the frequency and, to some extent, the quality of practical work in schools and colleges. Office for Standards in Education (OFSTED,

2005 b) reported that; if teachers do not select appropriate work it may result in pupils being taught the same content, often in the same way as they learned in the previous key stage. OFSTED also point out that the result of such an approach was de-motivating for pupils and is a poor use of teaching resources which could lead to 'disengagement and to a depressing of standards'.

Researchers have identified reasons that teachers had given for this state of affairs especially in Kenya, which included the fact that, too often teachers have felt they have to teach didactically to get through the content of programs of study or awarding body specifications. In the worst cases this is so that they can say they have taught it, regardless of whether pupils have understood or learned effectively. Similarly, where pupils only carry out instructions from worksheets to complete a practical activity, they are limited in the ways they can contribute. Some approaches to the Kenya Certificate of Secondary Education (KCSE) also have a narrowing effect such that the assessment of scientific enquiry through KCSE coursework using only a handful of experiments enables pupils to score highly but without deep scientific engagement (Grace, 2009)

Twoli (2006) states that "there has been considerable variation in the amount of practical work undertaken by students but, overall, students are doing less practical work now than in the past and often have had weaker practical skills at university level" (p. 222) Twoli further notes that the pursuit of scientific enquiry can make a significant contribution to the excitement of science and that pupils need to participate in all aspects of the investigation, forming hypotheses, planning, carrying out and evaluating results. However, the assessment of scientific enquiry through KCSE coursework has led to a narrowing of pupils' experience of enquiry contexts and skills.

2.6 Effects of time Allocated for Practical Activities on the Teaching and Learning of Biology

In terms of the relative weighting of different factors affecting teachers' use of practical work the major factor seems to be time. A survey of science teachers found that 64% lacked time for experiments (this figure rises to 68% among female science teachers; 71% among those aged 55+; and, 92% among those teaching in public secondary schools while many teachers said that safety rules had put them off. 87% of respondents said learning which allowed more experiments and scientific enquiry would have a significant impact on performance (Science Community Representing Education (SCORE) 2008)

A small-scale survey by NESTA (2005 a) in London reported that 50% of the respondents reported being unable to carry out practical activities because of behavioral problems, lack of equipment or class size. The respondents also said that when pupils were likely to be behaving badly, the use of gas burners and acids was not an option since they could cause extensive damage to school property in particular and the environment at large.

Kenya science teachers have also reported lack of time as a barrier to doing more practical work. For example, a recent small-scale study in Hong Kong, found that 'science teachers generally find inquiry-based laboratory work very difficult to manage' (Cheung, 2009, p. 107). Cheung went on to explain that the seven teachers in his study 'were most concerned about the lack of class time, shortage of effective instructional materials, and the need to teach large classes'

In terms of the focus and the quality of practical work, several authors note a lack of focus on teaching about the nature of science. For example, Lunetta, Hoftein and Clough (2007, p. 396) note that despite a succession of reforms to the science curriculum focusing on the promoting of the history of science 'the predominant pattern of science teaching visible in schools through the

turn of the twenty-first century has omitted the story of science'. On the contrary, they noted that 'the science visible in schools has focused on "covering" knowledge of science topics and limited problem-solving skills.' Worse still, 'laboratory activities have engaged students principally in following ritualistic procedures to verify conclusions previously presented by textbooks and teachers.' This point is echoed in the UK context where it was claimed that teachers tended to develop a narrow canon of experiments that allowed their students to gain higher marks than might more experimental, creative inquiries.

Gitomer and Duschl (1997) in their study found that teachers tended to see teaching as "dominated by tasks and activities rather than conceptual structures and scientific reasoning" (p. 65). Another US study, carried out in middle-schools by Kesidou and Rossman (2002), looked at nine widely-used teaching programs. The authors reported that: whereas key ideas were generally present in the programs, they were typically buried between detailed or even unrelated ideas. Programs only rarely provided students with a sense of purpose for the units of study, took account of student beliefs that interfere with learning, engaged students with relevant phenomena to make abstract scientific ideas plausible, modeled the use of scientific knowledge so that students could apply what they learned in everyday situations, or scaffolded student efforts to make meaning of key phenomena and ideas presented in the programs.

One of the challenges that teachers and researchers face is the difficulty in assessing the impact of practical work on students. For example, Millar (2004) points out the difficulties in evaluating the effectiveness of enquiry-based approaches in terms of conceptual development; as regards knowledge about science, the enquiry-based approach often aims for a largely tacit understanding. As a result, it is difficult to assess how successful it is, as the outcomes are rather imprecise and difficult to measure whether students becoming better enquirers of knowledge.

Some of the problems that children face when carrying out investigations have been pointed out by Keys (1998) who posits that children have difficulty making sense of the goals, purposes and motivation of investigations, while research emanating from the perspective of students' authentic questions has shown that children lack the processing strategies to conduct meaningful investigations.

The House of Lords Science and Technology Committee (2006) identified what it said was a critical issue in school science, a reported decrease in the volume and variety of practical work caused by a range of factors related to the assessment regime. As they put it; "some witnesses felt that the volume and variety of practical work in schools had lessened over time. A key cause of this was the focus on teaching to the test which squeezed out some types of practical work" (p. 110) They further point out that teachers are being required to achieve better examination results and one response to this has been to focus more on book learning which is more easily managed and assessed than practical work. Moreover, teachers had insufficient opportunity to learn about, and practice, activities before lessons and similarly many teachers complain that, with pressure to get through the syllabus, they cannot find room for much practical work. Another survey had reinforced these impressions, with a lack of time being cited by 64 per cent of teachers more than any other issue as a barrier to practical work.

The perceived lack of time to learn about and practice practical activities was compounded, according to witnesses, by teachers' desire to maximize opportunities for their pupils to score highly in tests: even when teachers can find time for practical work, there is concern about the lack of variety, particularly at KCSE level (Grace, 2009)

2.7 Summary of Review of Related Literature and Analysis of Knowledge Gap

The literature review revealed that practical work is essential to the teaching and learning of chemistry as students are likely to grasp more difficult concepts when they undertake practical activities which also goes a long way in making learning more permanent. This review also showed that the benefits of practical work are not only for the students but the teachers as well hence making teaching and learning more motivational, enjoyable and easier. Several factors were also seen to affect the planning and detaching of practical activities in secondary schools. Factors such as: influence of learners' attitude towards practical work on the teaching and learning of biology, the attitude of teachers towards teaching biology practical work, the opinions of teachers and students towards the aims of biology practical work, the contributions of practical work towards the improvement of students' interest in learning biology, influence of the quality of laboratory materials on the learning of Biology practical and the effects of time allocated for practical work on the teaching and learning of sciences. These factors were noticed to increase, enhance or encourage students' achievement or diminish students' achievement all together.

As the review showed, a great deal of research has been undertaken with respect to school practical activities and there seems to be a strong positive correlation between practical activities and student motivation, interest and achievement in sciences in general. However, apparently, nothing has been done to show if the extent to which practical activities in Biology actually has an influence on the teaching and learning of Biology in particular. The researcher therefore deemed it necessary to fill in the missing link left by earlier studies with regards to Biology as a whole by trying to find out the extent to which practical work/activities influence the teaching and learning of Biology. This study is therefore aimed at studying the influence of practical work

on the teaching and learning of biology and it is sure that the study will greatly contribute to the field of education at large and specifically to the field of science and Biology in particular in the area of practical activities.

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

This chapter described the research design and methodology of the study under the following sub-headings: research design, population of the study, description of the sample size and sampling techniques, description of data collection instruments, validity and reliability of the instruments, data collection procedures, data analysis techniques and ethical considerations.

3.1 Research Design

A research design according to Leedy and Omrod (2001) is a set of actions which a researcher develops to provide criteria and specifications for a study or a research. Kombo and Tromp (2007) add that a research design is a collection of conditions for collecting and analyzing data in a way that aims to integrate relevance with the research purpose. They further describe a research design as a conceptual structure within which the research is conducted. Khothari (2004) in supporting this notion opine that a research design aims at the arrangement of conditions for collecting and analyzing data in a manner that combines the ideas of the research purpose with economy in procedure. Thus a research design is necessary for every research because it facilitates the various research operations thereby making it as efficient as possible and producing maximum information with minimum expenditure as far as funds, time and energy are concerned.

This research adopted a quantitative paradigm. It specifically used survey in its design which according to Nassiuma (2000) entails the asking of questions to selected group of people who write their responses after reflecting about them. This study specifically used the cross-sectional

survey in obtaining quantitative data on the influence of practical work on the teaching and learning of biology in public secondary schools, in Dagoretti Sub-County, Nairobi County.

3.2 Population of the Study

A target population is, as defined by Mugenda and Mugenda (2003), a population which the researcher wants to use to generalize the results of a study. They add that it is an aggregate of all that conforms to a given specification. Kombo and Tromp (2006) further note that a target population is also a group of individuals, objects or items from which samples are taken for measurement. Kisilu (2006) describes a target population also as a group about which a researcher aims to make assumptions. In this light all the 43 form four students as well as all the form four teachers from three public secondary schools in Dagoretti sub-county will constitute the target population of this study.

The population in this study involved the teachers and students in three public secondary schools in this area. The researcher wanted to use the teachers in the study because they have more experience in teaching and learning especially in practical activities. The study also involved the students in order to determine their views on the influence of practical work on the teaching and learning of biology.

3.3 Description of Sample Size and Sampling Techniques

Khothari (2004) defines a sample as a part of the statistical population whose properties are studied in order to obtain information about a whole while Kombo and Tromp (2007) define sampling as a process of selecting a number of individuals or objects from a population such that the selected group contains elements representative of the characteristics found in the entire

group. Singh and Nath (2007) observe that it is impossible to do research with the whole population due to limitations in cost, time and other factors which make it difficult for the researcher to get information from the whole population. From the ten public secondary schools in Dagoretti sub-county, the researcher used simple sampling method in the choosing of the three public secondary schools.

In the selection of the sample of students for the study, simple random sampling was used. This is because the students are many and the researcher does not intend to select either a particular group of students or a certain gender. This also provided equal chances for each student to be included in the sample. The sample size of the students in the sampled secondary schools will be done by getting at least 30% of the total population (Kombo and Tromp, 2007)

3.4 Description of Data Collection Instruments

A research instrument is a tool of collecting data from the sample, data being the information needed, as Nsubuga (2000) posits, to solve a problem. In order to realize the enumerated objectives of the study, the researcher used questionnaires. Two sets of questionnaires; questionnaire for students and questionnaire for teachers were used to obtain a data from the sample population.

3.4.1 Questionnaire for the Students

The questionnaire was formulated in line with the objectives of the study. The researcher divided the questionnaire for the students into four sections: Section A dealt with demographic information of the students and Section B dealt with the influence of learners' attitude towards practical work on the teaching and learning of Biology, section C with the opinions of teachers

and students towards the aims of Biology practical work, and section D dealt with the contributions of practical work towards the improvement of students' mastery of the Biology subject, the influence of the quality of laboratory materials on the learning of Biology practical and the effects of time allocated for practical work on the teaching and learning of Biology.

The questionnaire consisted of questions and statements that will either be open-ended or closed-ended. The closed ended questions on the one hand were arranged in such a way that the respondents will be provided with a list of responses from which appropriate answers will be selected. These will range from agree (A), undecided (UN), to disagree (D). On the other hand, open ended questions required the respondents to provide their own answers.

3.4.2 Questionnaire for Teachers

The questionnaire for teachers were similar to those of the students except for a few modifications in the first section concerning the demographic information of the teachers. The questionnaire for the teachers were divided into five sections: Section A dealt with demographic information of the teachers and Section B dealt with the influence of learners' attitude towards practical work on the teaching and learning of Biology, section C with the attitude of teachers towards teaching Biology practical work, section D with the opinions of teachers and students towards the aims of Biology practical work, and section E dealt with the contributions of practical work towards the improvement of students' mastery of the Biology subject, the influence of the quality of laboratory materials on the learning of Biology practical and the effects of time allocated for practical work on the teaching and learning of Biology.

3.5 Validity and Reliability of Instruments

The validity of a research according to Nassiuma (2000) is the degree to which the observed outcome reflects the expected. Furthermore, the validity is manifested by the accuracy and the authenticity of the methods applied. Mugenda and Mugenda (2003) define validity on their part as the accuracy and meaningfulness of inferences which are based on the research results. To add to that, validity can be seen as the degree to which results obtained from the analysis of the data actually represent the phenomenon under study. Orodho (2009) also notes that validity is concerned with the degree to which an empirical measure or several measures of a concept accurately represent that concept. The principle of validity requires that one asks quite genuinely if the items in the measuring instruments singly or collectively represent what they are supposed to measure. Mugenda and Mugenda (2003) are of the opinion that the validity of an instrument is enhanced through the judgment by experts. The researcher accomplished content validity of the instrument by pursuing knowledge from professionals in education, especially in the field of Biology and equally make good use of the assistance and guidelines of the supervisor.

3.6 Data Collection Procedures

Data collection is described as the gathering of specific information in order to provide and support some facts or refute some assertions (Kombo and Tromp, 2007). A permission letter was obtained from the university (MIUC) to the schools where the data were collected. The permission letter was submitted to the authorities or Head teachers or principals of the schools which were among the sampled schools for this research. It served as a letter of authenticity for the schools to permit the researcher to collect data. The questionnaires were administered to the respondents through the assistance of the schools' principals or head teachers.

3.7 Data Analysis Techniques

Data was analyzed quantitatively. Descriptive statistics was used and summaries presented graphically using tables and figures. The researcher used Statistical Package for Social Sciences (SPSS) to analyze and present the data. The reason for choosing SPSS is because it is an effective data management tool, it has wide range of options, it is relatively easy to use, it is time-saving and reliable.

3.8 Ethical Considerations

As Mugenda and Mugenda (2003) put it, research ethic focuses on the application of ethical standard in the planning of study, data collection, analysis and dissemination as well as use of results. As mentioned above, the permission to collect data to the different secondary schools will be obtained from the Head teachers or Principals of the schools where the researcher will conduct his research

The researcher also assured the respondents of the confidentiality in the data collection exercise and in dealing with their responses. This was done by neither mentioning names of schools nor names of individual respondents. All sources of the information/literature for this research were acknowledged in the reference list in accordance with the American Psychological Association 6th edition (APA) style with regards to academic integrity.

CHAPTER FOUR

PRESENTATION, INTERPRETATION AND DISCUSSION OF THE FINDINGS

In this chapter, the data collected by the researcher were presented, interpreted and discussed. The research was based on the objectives of the study from which the questionnaires were formulated. The researcher administered 90 questionnaires for students and 12 for teachers and of these, 87 questionnaires for students and 11 for teachers were returned. The researcher used the Statistical Package for Social Sciences (SPSS) to analyze the data and used the statistical descriptive methods such as; frequency tables, percentages and bar charts to illustrate the presentations. The first part dealt with demographic information of the respondents and the latter with the objectives of the study.

4.1 Demographic Information of Respondents

The researcher sought to obtain the demographic information of the respondents in terms of gender and age.

4.1.1 Gender of Students and Teachers

Table 4.1 displays the gender of the Students and Teachers

Table 4.1

Gender of Students and Teachers

Gender	**Students**		**Teachers**	
	f	%	*f*	%
Male	54	62	4	25
Female	33	38	7	75
Total	**87**	**100**	**11**	**100**

Table 4.1 on the one hand shows that 62% of the students were male while 38% were female. This illustrates that both female and male students participated in the study and that the research was based on the views of both genders. On the other hand, the table also shows that 25% of the teachers were male and that 75% were female. This equally reveals that the research was based on the views of both genders. The table yet poses a challenge as to why the ratio of male students is higher than that of the female students doing science especially Biology while the ratio of female science teachers is higher than that of male science teachers.

4.1.2 Age of Students and Teachers

Table 4.2 shows the gender of the teachers and students.

Table 4.2

Age of Students and Teachers

Age	**Students**		**Teachers**	
	f	%	*f*	%
12-15 years	11	12.6		
16-20 years	74	85.1		
Above 20 years	2	2.3	11	100
Total	**87**	**100**	**11**	**100**

Table 4.2 shows the distribution in age of the students and teachers in the three public secondary schools in Dagoretti Sub-County where the research was conducted. The table exemplifies that 12.6 % of the students were between 12-15 years, 85.1.2% were between 16-20 years and 2.3%

were above 20 years. The table shows equally that all the teachers were above 20 years. These findings show that the mean age of all the respondents is 18 years and Solomon, J. (1980) posited that at this age people move beyond concrete experiences and begin to think abstractly, reason logically and draw conclusions from available information. With the aforementioned, the researcher can conclude that the respondents were mature enough to understand the questions and draw conclusions.

4.2 Influence of Learners' Attitudes towards Practical Work on the Teaching and Learning of Biology

4.2.1 Influence of Practical Work on Students' Acquisition of Experimental Skills

Figure 4.1 illustrates the influence of practical work on students' acquisition of experimental skills

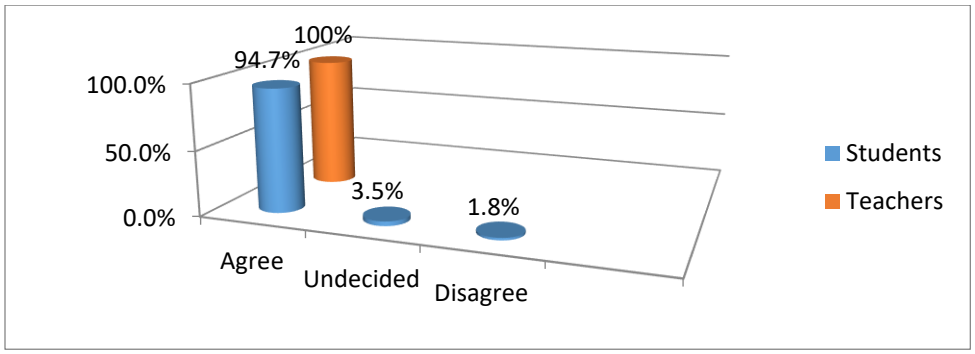

Figure 1: Influence of Practical Work on the Acquisition of Experimental Skills

As shown in figure 4.1, 93.7% (94%) of the students agreed that practical work influences the acquisition of experimental skills. 3.5% (4%) of students were undecided while 1.8% (2%) disagreed with the motion. Given that 100% of the teachers also agreed to the assertion, the researcher therefore concluded that practical work influences the acquisition of experimental skills. This view was also echoed by Twoli (2006).

4.2.2 Students use all their Senses in Learning Biology when doing Practical Work

Table 4.3 exemplifies that students use all their senses in learning biology when doing practical work.

Table 4.3

Students use all their Senses in Learning Biology when doing Practical Work

	Students		Teachers	
	f	%	*f*	%
Agree	46`	63.2	11	100
Undecided	20	17.5		
Disagree	21	19.3		
Total	87	100	11	100

It holds true for the motion that students use all their senses in learning chemistry when performing practical tasks. This is corroborated by Table 4.3 which shows that 63.2% (63%) of the students agreed, 17.5% (18%) were unsure while 19.3% (19%) were in disagreement. 100% of the teachers agreed with the statement.

4.2.3 Practical Work makes Learning of Biology more Difficult

Table 4.4 explains how students and teachers felt about the assertion that practical work makes the learning of biology more difficult.

Table 4.4

Practical Work makes Learning of Biology more Difficult

	Students		**Teachers**	
	f	%	*f*	%
Agree	34`	42.1	3	25
Undecided	17	12.3		
Disagree	36	45.6	8	75
Total	**87**	**100**	**11**	**100**

As Table 4.4 shows, 42.1% (42%) of the students felt that practical work makes the learning of biology difficult, 12.3% (12%) were undecided and 45.6% (46%) disagreed that practical work makes the learning of biology more difficult. Given that 25% of the teachers also agreed with the statement and 75% felt otherwise, the researcher holds as Toplis (2012) that students and teachers need to have a more positive attitude towards practical work for effective teaching and learning of biology.

4.2.4 Mathematics should be avoided in Practical Work

Figure 4.2 explains how students and teachers felt about incorporating mathematics in practical work.

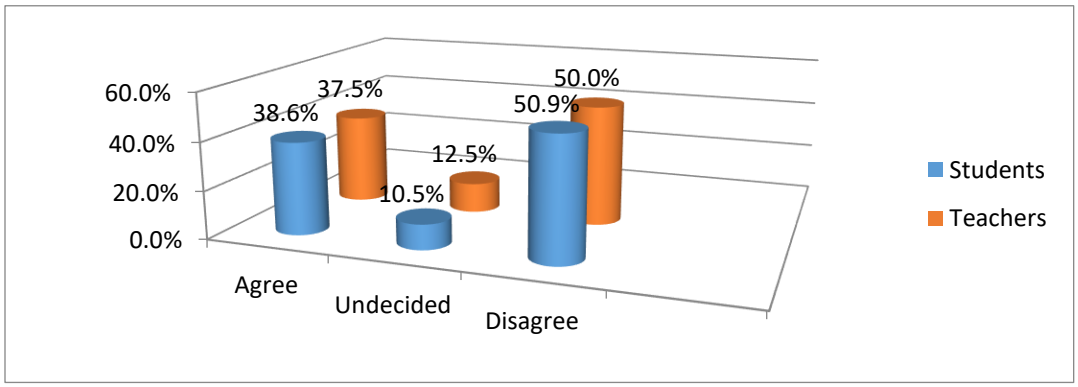

Figure 2: Avoidance of Mathematics in Biology Practical Work

As Figure 4.2 suggests, a good number of students 50.9% (51%) and teachers 50% disagreed for mathematics to be avoided in biology practical work. The figure also shows that 38.6% (39%) and 37.5% (38%) agreed with the notion while 10.5% (11%) and 12.5% (13%) of students and teachers respectively were unsure about the declaration.

4.2.5 Practical Work is too demanding for Students

Table 4.5 gives an explanation to the feeling of the students and teachers on the suggestion that practical work is too demanding for the students.

Table 4.5

Practical Work is too demanding for Students

	Students		**Teachers**	
	F	%	*f*	%
Agree	32`	38.6		
Undecided	24	24.6	3	25.0
Disagree	31	36.8	8	75.0
Total	**87**	**100**	**11**	**100**

Table 4.5 illustrates that 38.6% (39%) of the students felt that practical exercises are too demanding for them whereas 24.6% (25%) were undecided and 36.8% (37%) disagreed with the statement or felt that practical work was not too demanding. The majority of the teachers 75% on their part disagreed with the statement and 25% were undecided.

4.2.6 Students' Preference of Independence during Practical Lessons

Table 4.6 draws insights as to whether students preferred to do practical lessons on their own or with the help of a teacher.

Table 4.6

Students' Preference of Independence during Practical Lessons

	Students		**Teachers**	
	F	%	*f*	%
Agree	47`	64.9	7	75.0
Undecided	16	10.5	2	12.5
Disagree	24	24.6	2	12.5
Total	**87**	**100**	**11**	**100**

As Table 4.6 points out 64.9% (65%) of students would prefer doing practical lessons on their own, 10.5% (11%) were not sure while 24.6% (25%) sought the assistance of the teacher when carrying out practical exercises. Majority of the teachers 75% were of the same opinion that students need to be independent in carrying out practical work. Thus, students needed to depend more on themselves than on the teacher when carrying out practical work.

4.2.7 Practical Work Increases Students' Interest in Learning Biology

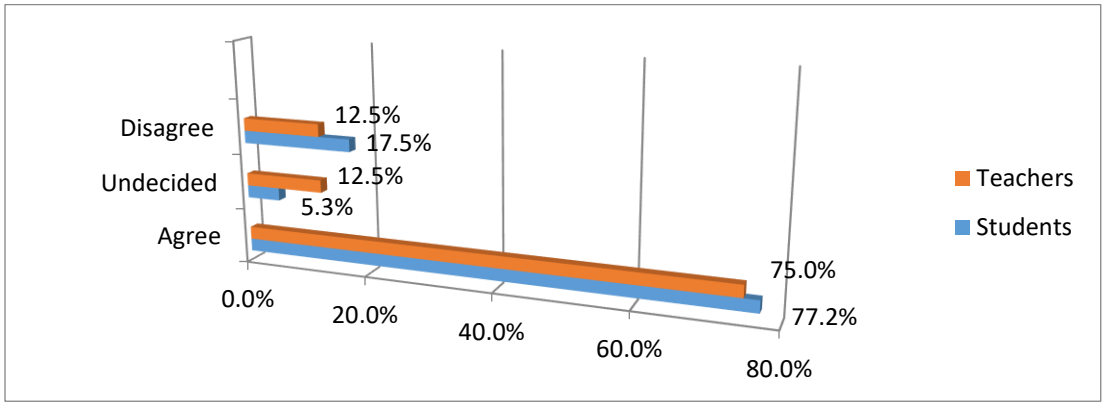

Figure 3: Influence of Practical Work on Students' Learning of Biology

Figure 4.3 points up on the one hand that 77.2% (77%) of the students agreed that practical work increases their interest in learning biology. 5.3% (5%) were undecided while 17.5% (18%) disagreed with the motion. On the other hand, 75% of the teachers agreed, 12.5% (13%) were undecided and 12.5% (13%) also disagreed that practical work increases the interest of students in learning biology. The conclusion here is as Gastel (2007) pointed out that practical work actually increases the interest of students in learning biology.

4.2.8 Students' Preference of Reading Biology Books to Doing Experiments

Table 4.7 explains students' choice of reading biology books over doing experiments

Table 4.7 Students' Preference of Reading Biology Books to Doing Experiments

	Students		**Teachers**	
	f	%	*f*	%
Agree	28	31.6	4	31.5
Undecided	23	22.8	2	12.5
Disagree	36	45.6	5	50.0
Total	**87**	**100**	**11**	**100**

A good number of students 45.6% (46%) disagreed that they would rather read their books to doing experiments. 22.8% (23%) were undecided while 31.6% (32%) felt they would prefer reading their books than doing practical work. From the teachers 31.5% (32%) agreed, 12.5 (13%) and 50% disagreed with the statement that students would prefer to read their books rather than do practical work.

4.3 The Attitude of Teachers towards Teaching Biology Practical Work

4.3.1 Practical Work is an Important Part of the Biology Syllabus

Figure 4.4 shows how teachers felt about practical work being a part of the biology syllabus.

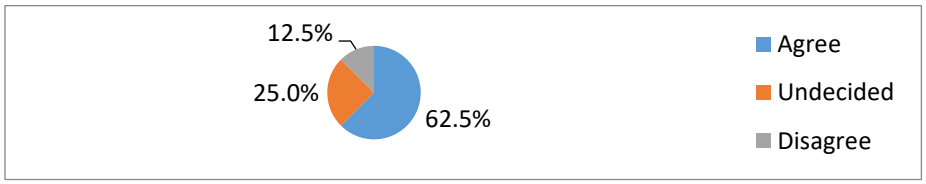

Figure 4: Opinion of Teachers on Practical Work as an Important Part of the Biology Syllabus

According to Figure 4.4 majority of the teachers 62.5% (63%) agreed that practical work is an important part of the biology syllabus. 25.5% (26%) were undecided while 12.5% (13%)

disagreed with the motion. Thus, the researcher concluded as Grace (2009) that practical work is an important part of the biology syllabus.

4.3.2 Practical Work Increases Students' Interest in Learning Biology

Table 4.8 seeks to illustrate whether practical work increases students' interest in learning Biology.

Table 4.8

Practical Work Increases Students' Interest in Learning Biology

	Teachers	
	f	%
Agree	11	100
Total	**11**	**100**

Given the overwhelming response of the teachers (100%) the researcher concluded that practical work increases the interest of students in learning Biology (Gastel, 2009)

4.3.3 Practical Skills are more important than getting Right Answers

Figure 4.5 gives an insight as to whether students' acquisition of practical skills is more important than just getting right answers.

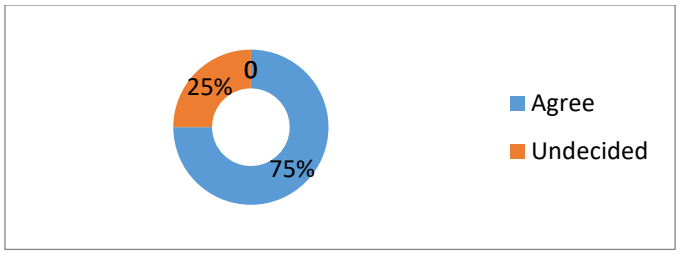

Figure 5: Students' Acquisition of Practical Skills is more important than just getting the Right Answers

Figure 4.5 helps draw the conclusion in line with KNEC (2004) that students' possession of practical skills is more important than just getting right answers. This is supported by the fact that 75% of the teachers agreed with the statement that practical skills are more important than getting the right answers while 25% were not sure.

4.3.4 Significance of Practical Work in making new Discoveries

Figure 4.6 shows the significance, according to teachers, of practical work in making new discoveries.

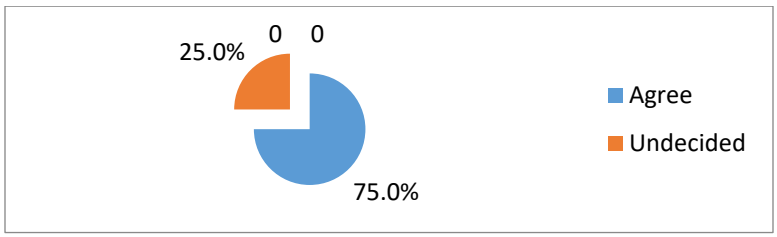

Figure 6: Importance of Practical work in making New Discoveries

The study found that practical work is an indispensable part of making new discoveries. This is supported by the fact that 75% of the teachers agreed with the statement that practical skills are more important than getting the right answers while 25% were not sure.

4.3.5 Experiments help in Boosting Students' Understanding of Theory

Table 4.9 explores the motion that experiments help in boosting students' understanding of theory.

Table 4.9

Experiments help in Boosting Students' Understanding of Theory

	Teachers	
	f	%
Agree	11	100
Total	**11**	**100**

Given that all the teachers agreed that experiments boost students' understanding of theory the researcher therefore concluded the same.

4.3.6 Teaching Practical Work is very Enjoyable

Teachers' attitude towards the teaching of practical work is explained in Table 4.10

Table 4.10

Teaching Practical Work is very enjoyable

	Teachers	
	f	%
Agree	11	100
Total	**11**	**100**

All the teachers equally felt that it is pleasurable teaching practical work as indicated by the figures in Table 4.10.

4.3.7 Attitude of Teachers towards Students' Performance of Practical Tasks by Themselves

The feeling of teachers as to whether students learn better when performing practical tasks by themselves is expressed in Figure 4.7

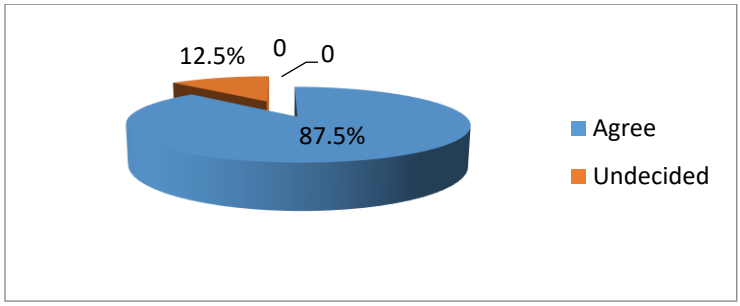

Figure 47: Attitude of Teachers towards Students' Performance of Practical Tasks by Themselves

The results displayed by figure 4.7 shows that majority of the teachers 87.5% felt that students learn better when they perform practical tasks by themselves. 12.5% of the teachers still felt that teachers' guidance is needed when students perform practical work.

4.4 Opinions of Teachers and Students Towards the Aims of Biology Practical Work

4.4.1 Practical work is meant to teach basic Practical Skills

Table 4.11 explains how teachers and students felt about practical work aiming at teaching basic practical skills.

Table 4.11

Practical work is meant to teach basic Practical Skills

	Students		**Teachers**	
	f	%	*f*	%
Agree	57	82.5	11	100
Undecided	14	7.0		
Disagree	16	10.5		
Total	**87**	**100**	**11**	**100**

From Table 4.11 it is evident that majority of the respondents feel that practical work in secondary schools is aimed at teaching basic practical skills. A number of skills associated with science and biology in particular have been documented. According to Weld (2004), scientific skills may be categorized into two main forms; basic process skills and integrated process skills. Basic process skills include observing, classifying, measuring, communicating, inferring and predicting while integrated process skills include experimenting, formulating hypothesis, collecting and representing data, interpreting and analyzing data and making conclusions. This also agreed with the notion of Grace (2009) that practical work is meant to teach basic skills.

4.4.2 Practical Work is meant to Familiarize Students with Standard Apparatus and Measuring Techniques

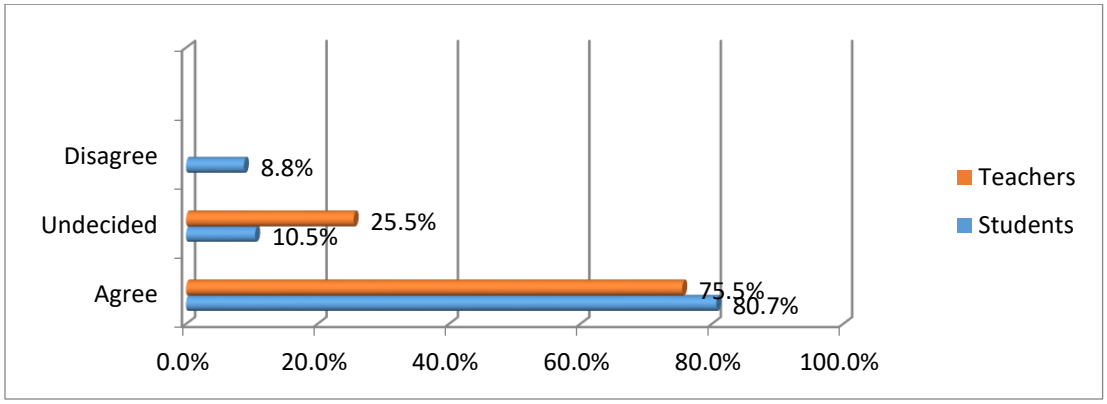

Figure 8: Students' Familiarity with Standard Apparatus and Measuring Techniques through Practical Work.

Figure 4.8 displays that 75.5% of teachers and 80.7% of students agreed that practical work is meant to familiarize students with standard apparatus and measuring techniques in biology. No teacher disagreed with the statement yet 25.5% were undecided. Some students disagreed while others were also undecided. Grace (2009) on the contrary opined that practical work is also meant to instill in students integrated process skills such as hypothesis formulation.

4.4.3 Practical Work is Meant to Train Students in Making Observations

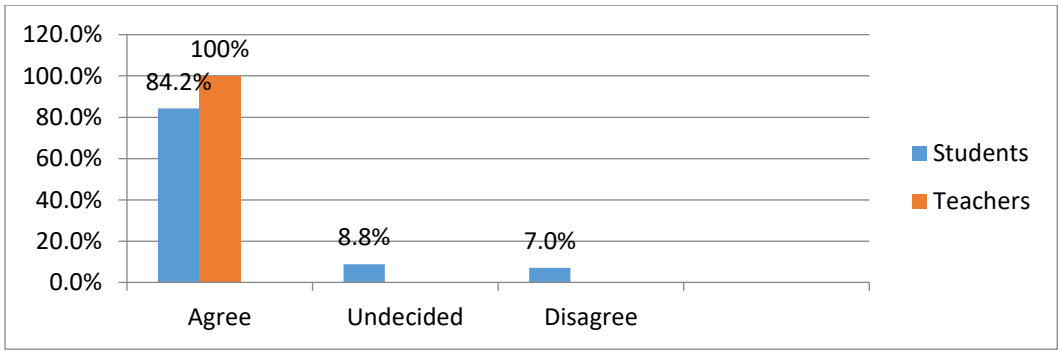

Figure 9: Practical Work Geared Towards Students Making Observations

According to Figure 9 and supported by Shulman and Tamir (2008) a bulk of the respondents agreed that practical work is geared towards training students in making observations in biology

4.4.4 Practical Work is Meant to Train Students in Recording Observations

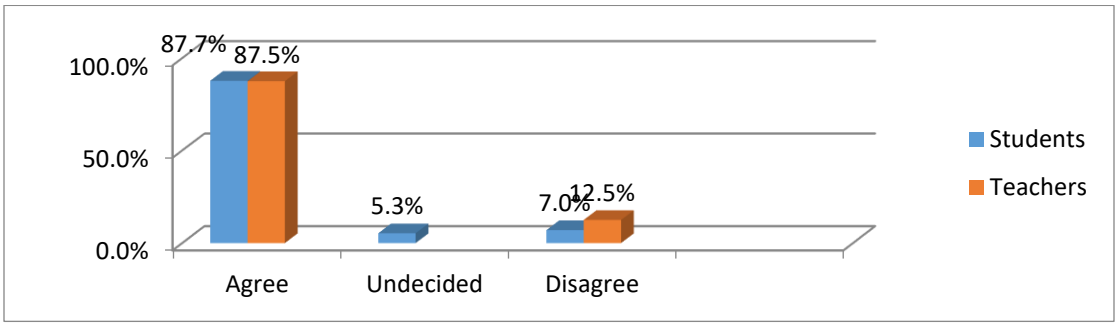

Figure 10: Practical Work is Meant to Train Students in Recording Observations

87.7% of students and 87.5% of teachers according to Figure 4.10 agreed that practical work is meant in biology to train students on how to record observations made during practical exercises. The feeling did not cut through as 7% and 12.5% of students and teachers respectively disagreed with the motion. 5.3% of students yet were unsure. Gott and Duggan (2005) found out the same in their study.

4.4.5 Practical Work is Meant to Train students in Making Deductions and Interpretations of Experimental Data

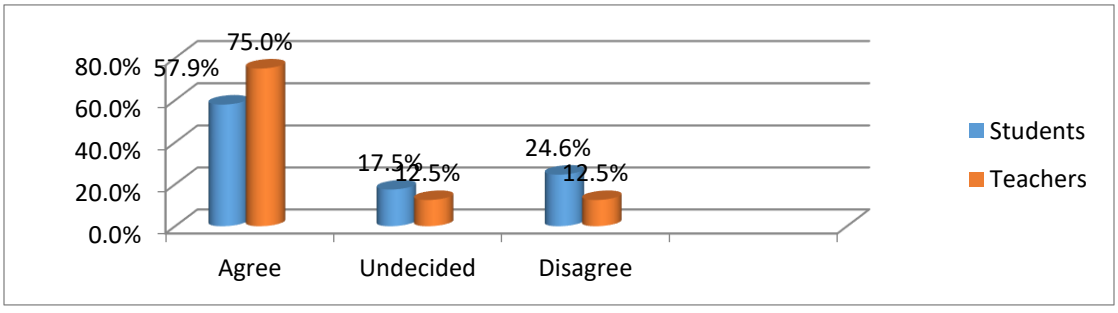

Figure 11: Students Learn to make Deductions and Interpretations of Experimental Data through Practical Work

Figure 4.11 points out that there were mixed feelings about practical work aiming at training students in making deductions and interpretations of experimental data. The House of Lords Science and Technology Committee made the same observations in 2006.

4.4.6 Practical Work is Meant to use Experimental data to Solve Specific Problems

Table 4.12 explains how students and teachers felt about practical work aiming at enabling students use experimental data in solving specific problems.

Table 4.12

Practical Work is meant to use Experimental Data to Solve Specific Problems

	Students		**Teachers**	
	f	%	*f*	%
Agree	42	63.2	9	87.5
Undecided	16	10.5	2	12.5
Disagree	25	26.3		
Total	**87**	**100**	**11**	**100**

As table 4.12 shows 63.2% of students agreed with the aim, 10.5% were undecided while 26.3% disagreed with the aim. On the part of the teachers 87.5% agreed while 12.5% were still undecided.

4.4.7 Practical work is meant to train students on writing reports on experiments

Table 4.13 explains the sentiments of the respondents about practical work seeking to train students on writing reports on experiments.

Table 4.13

Practical Work is Meant to Train Students on Writing Reports on Experiments

	Students		Teachers	
	f	%	*f*	%
Agree	42	56.1	9	87.5
Undecided	21	19.3	2	12.5
Disagree	24	24.6		
Total	**87**	**100**	**11**	**100**

Following from Table 4.13, 56.1% of the students and 87.5% of the teachers felt that practical work should aim at teaching students how to write laboratory reports. 19.3% of students and 12.5% of teachers were undecided about this aim while 24.6% of students disagreed.

4.4.8 Practical Work is Meant to Train Students in Simple Aspects of Experimental Design

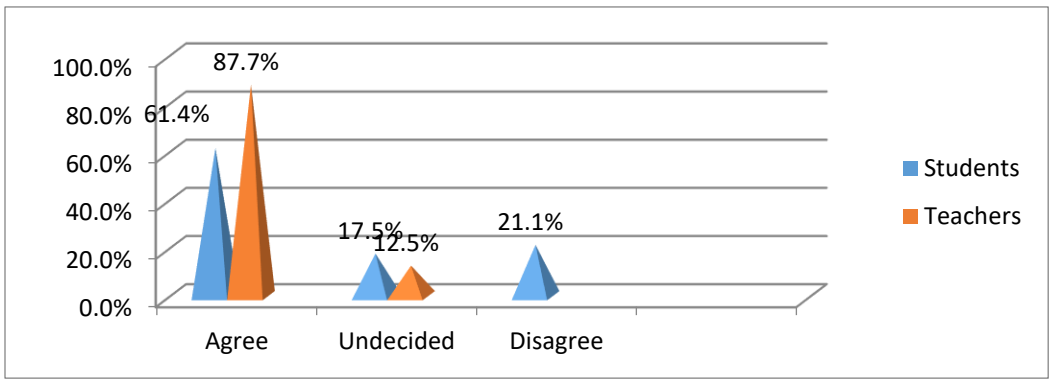

Figure 12: Students Learn Simple Aspects of Experimental Design through Practical Work

The researcher concluded as per the results displayed by Figure 4.12 that students learn simple aspects of experimental design through practical work. This is because a greater part of the

respondents agreed with the statement. Grace (2009) disagreed with this observation and posited that students are to learn both simple and complex experimental designs through practical work.

4.4.9 Practical Work is Meant to Arouse and Maintain Students' Interest in the Subject

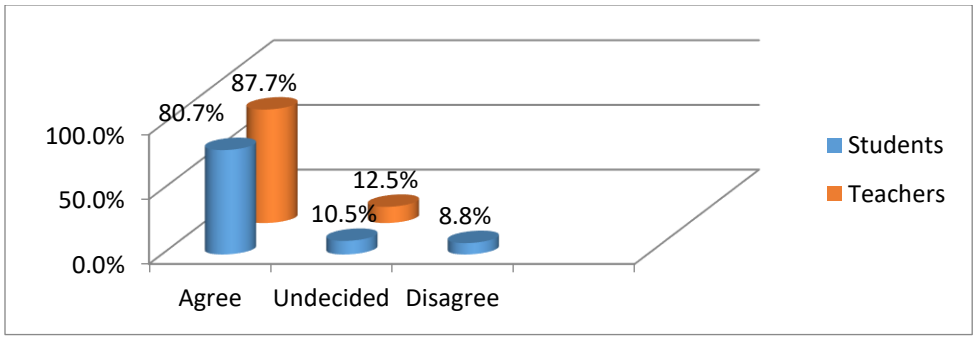

Figure 13: Arousal and Maintenance of Students' Interest through Practical Work

To a greater extent according to Figure 4.13, the respondents shared the sentiment as Gastel (2007) that practical work should aim at arousing and maintaining the interest level of students in biology. To a lesser extent some disagreed while others were undecided.

4.4.10 Practical Work is Meant to Show the use of Practical Work as a Process of Discovery

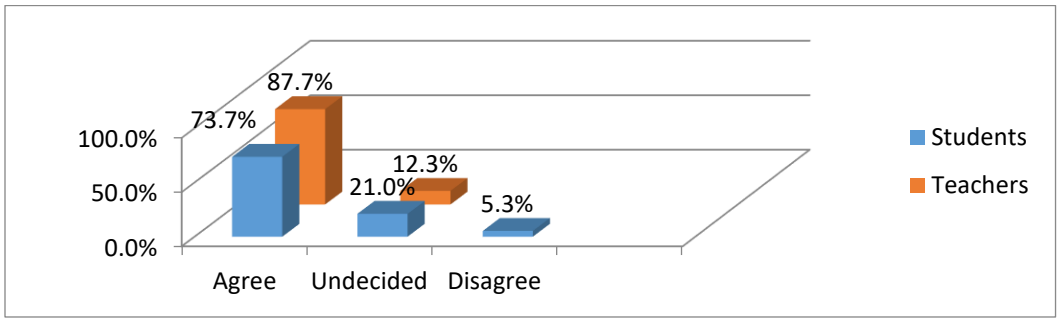

Figure 14: The Use of Practical Wok as a Process of Discovery

A mainstream of the respondents 73.7% students and 87.7% teachers felt that practical wok is meant to show practical work as a process of discovery (Twoli, 2006). Some yet disagreed while others were undecided.

4.4.11 Practical Work is meant to Verify Scientific Facts

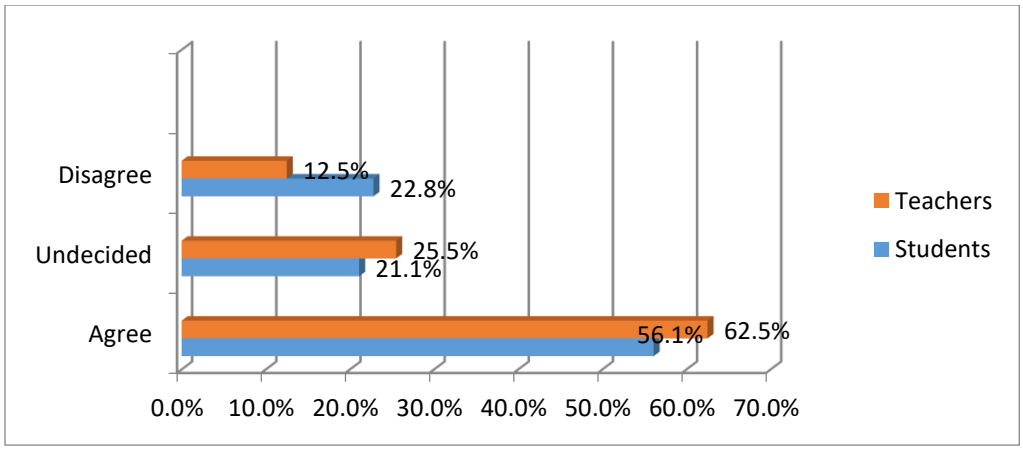

Figure 15: Verification of Scientific Facts through Practical Work

Given the information displayed on Figure 4.15 the researcher held contrary to Hodson (2007) that there were mixed feelings on the notion that practical work is meant to verify facts.

4.4.12 Practical Work is Meant to Help Bridge Theory and Practice

Table 4.14 helps explain what respondents' sentiments were on the notion that practical work should be meant to bridge the gap between theory and practice.

Table 4.14

Practical Work is Meant to Help Bridge Theory and Practice

	Students		**Teachers**	
	f	%	*f*	%
Agree	48	66.7	9	87.5
Undecided	20	17.5	2	12.5
Disagree	19	15.8		
Total	**87**	**100**	**11**	**100**

Table 4.14 shows that 66.7% and 87.5% of students and teachers respectively, agreed that practical work should aim at bridging the gap between theory and practice. 12.5% of teachers and 17.5% of students were undecided while 15.8% of students disagreed with the notion. The researcher drew similar conclusions with Clackson and Wright (1992) that practical work indeed should bridge the gap between theory and practical.

4.4.13 Practical Work is meant to Train Students on How to Raise and Answer Questions on Scientific Phenomena

Figure 4.16 displays that respondents had a mixed feeling over the motion that practical work is meant to train students on how to raise and answer questions on scientific phenomena given that only a few over 50% of the respondents agreed with the statement. This is in accordance with Abrahams and Miller (2008) who found out in their study that there is still a problem in the science sphere with understanding the true purpose of practical work.

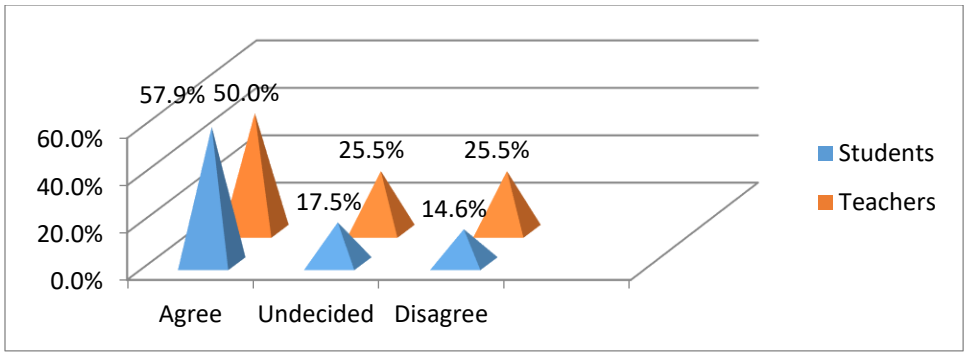

Figure 16: Practical Work Aiming at Training Students on How to Raise and Answer Questions on Scientific Phenomena.

4.4.14 Practical Work is Meant to Train Students on Hypothesis Formulation

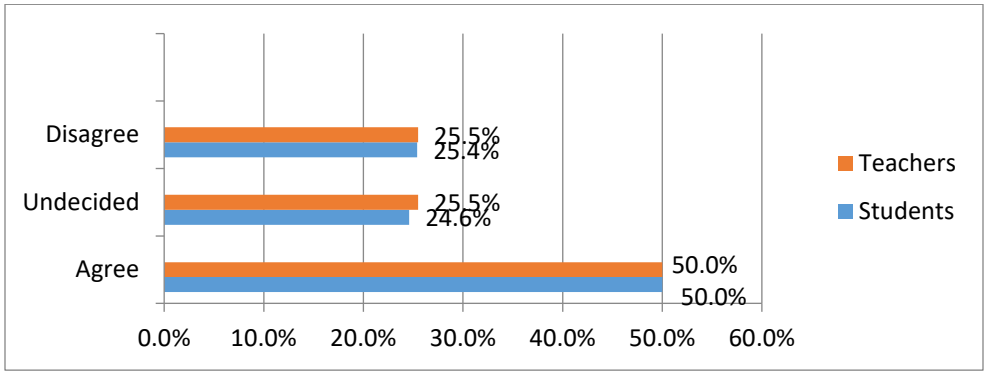

Figure 17: Sentiments of Respondents over Practical Work gearing Towards Training Students on Hypothesis Formulation

Given that only 50% according to Figure 4.17 of the respondents agreed with the aim that practical work trains students on hypothesis formulation, the researcher deduced that respondents have mixed feelings about the statement. This is in line with Grace (2009) who opined that many at times basic practical skills are preferred over integrated process skills in practical lessons.

4.5 Contributions of Practical Work towards the Improvement of Students' Interest in Learning Biology

4.5.1 Influence of Practical Work on Students' Learning of Biology

Figure 4.18 indicates the attitude of teachers and students towards the influence of practical work on the improvement of students' interest in learning biology.

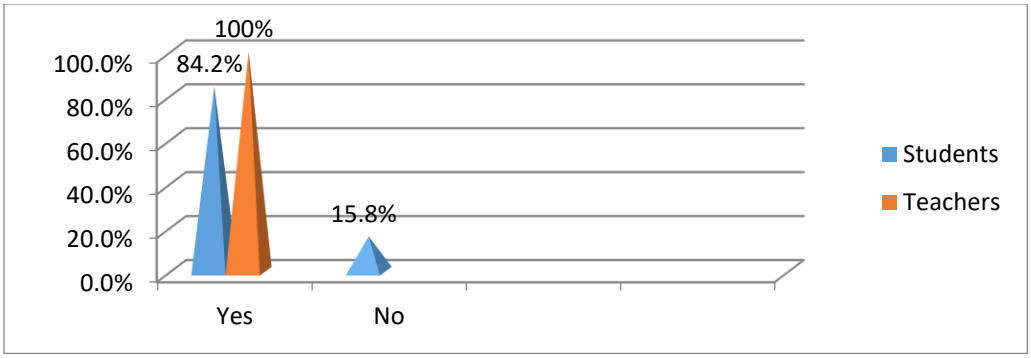

Figure 18: Influence of Practical Work on Students' Learning of Chemistry

Given that only 15.8% of students disagreed with the question as to whether practical work increases students' interest in learning biology, and 84.2% of students and 100% of the teachers said yes to the question, the researcher concluded same as Gastel (2007) that practical work helps improve students' interest in learning biology.

4.5.2 Number of Laboratories in Schools

Table 4.15 shows the number of laboratories possessed by the schools.

Table 4.15

Number of Laboratories in the Schools

	Students		Teachers	
	f	%	*f*	%
3 Laboratories	30	35.1	2	12.5
2 Laboratories	31	54.4	9	87.5
1 Laboratory	16	10.5		
Total	**87**	**100**	**11**	**100**

Table 4.15 indicates that the majority of the schools had two laboratories that cater for the three science subjects (Biology, Chemistry and Physics). Some schools had three laboratories, one for each subject while others had one laboratory to perform experiments for all three science subjects.

4.5.3 Availability and Appropriateness of Laboratory Materials

4.5.3.1 Benches are in good condition

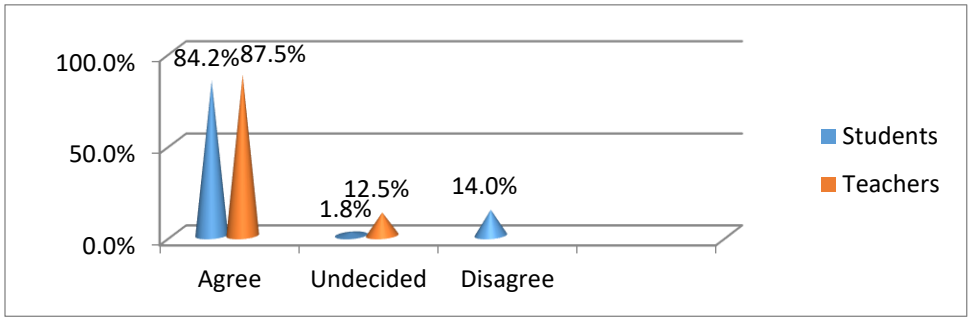

Figure 19: Availability and Appropriateness of Laboratory materials

According to the figure the greater part of the respondents agreed that they have good benches in their laboratories.

4.5.3.2 Good tap water

Table 4.16

Good tap water

	Students		Teachers	
	f	%	*f*	%
Agree	62	91.2	7	75.5
Undecided	13	5.3	3	25.0
Disagree	12	3.5		
Total	**87**	**100**	**8**	**100**

The Table 4.16 shows yet again that the better part of the respondents felt the tap water provided in the laboratories is of good condition.

4.5.3.3 Good Condition of Stools and benches

Table 4.17

Good Condition of Stools and benches

	Students		Teachers	
	f	%	*f*	%
Agree	59	86.0	11	100
Undecided	13	5.3		
Disagree	15	8.8		
Total	**87**	**100**	**11**	**100**

According to Table 4.17 the greater part of the respondents 86% of students and 100% of the students agreed that they have good benches in their laboratories. 5.3% of students were undecided while 8.8% disagreed.

4.5.3.4 Suitable Equipment

Table 4.18

Suitable Equipment

	Students		**Teachers**	
	f	%	*f*	%
Agree	65	96.5	11	100
Undecided	11	1.8		
Disagree	11	1.8		
Total	**87**	**100**	**11**	**100**

The majority of the respondents as indicated on Table 4.18 agreed that the equipment provided in the laboratories were suitable enough for practical work. Only to a lesser extent did the respondents feel that the equipment were not good enough.

4.5.3.5 Good Heating Apparatus

Table 4.19

Good Heating Apparatus

	Students		Teachers	
	f	%	*f*	%
Agree	65	96.5	11	100
Undecided	11	1.8		
Disagree	11	1.8		
Total	**87**	**100**	**11**	**100**

In Table 4.19 agreed 96.5% of the students and 100% of the teachers that the heating apparatus provided were good for carrying out effective practical exercises.

4.5.3.6 Functioning Fume Cupboard

Table 4.20

Functioning Fume Cupboard

	Students		Teachers	
	f	%	*f*	%
Agree	47	64.9	5	50.0
Undecided	16	10.5	2	12.5
Disagree	24	24.6	4	37.5
Total	**87**	**100**	**11**	**100**

Table 22 shows that 64.9% (65%) of the students and 50% of the teachers thought that the fume cupboard they had was in good condition. 10.5% of the students and 12.5% of the teachers were

still undecided about the issue while 24.6% (25%) of the students and 37.5% (38%) of the teachers disagreed.

4.5.3.7 Adequate Chemicals

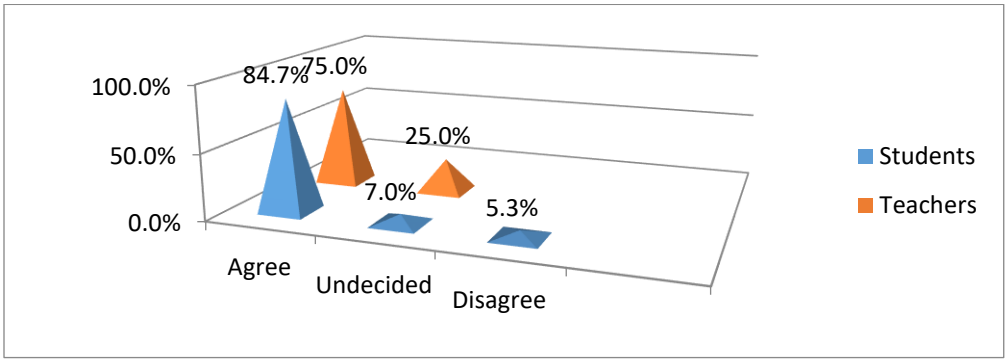

Figure 20: Availability of Adequate Laboratory Chemicals

The researcher concluded as also indicated by Figure 4.20 that there are adequate chemicals provided for the students to carry out practical exercises.

4.5.3.8 First Aid Box

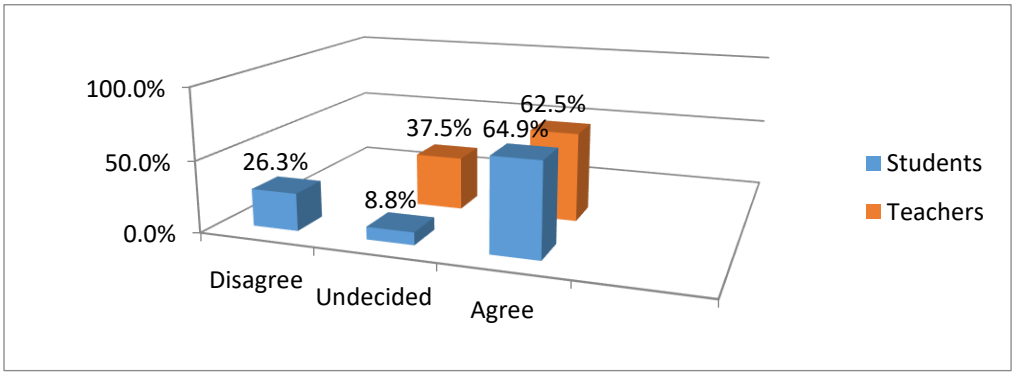

Figure 21: Availability and Adequacy of First Aid Box

The greater part of the respondents agreed, 64.9% of students and 62.5% of teachers that they had a first aid box in the laboratory. 26% of the students disagreed while 8.8% were unsure and 37.5% of the teachers were undecided about the matter.

4.5.3.9 Adequate Chemical Store

Table 4.21

Adequate Chemical Store

	Students		Teachers	
	f	%	*f*	%
Agree	55	78.9	11	100
Undecided	17	12.3		
Disagree	15	8.8		
Total	**87**	**100**	**11**	**100**

The respondents as shown by Table 4.21 agreed that the chemical store for the laboratory was adequate for storage of chemicals.

4.5.4 Duration of Laboratory Materials

Table 4.22 presents what respondents thought about the duration of the laboratory materials in the schools.

Table 4.22

Duration of Laboratory Materials

	Students		Teachers	
	f	%	*f*	%
Whole year	45	52.6	7	62.5
Part of the year	42	47.4	4	37.5
Total	**87**	**100**	**11**	**100**

The Table illustrates that 52.6% of students and 62.5% of teachers thought that the laboratory materials they had can last for the whole year. But 47.4% of students and 37.5% of teachers thought that the laboratory materials they possessed could only last for a part of the year.

4.6 Influence of Time Allocated for Practical Work on the Teaching and Learning of Biology

4.6.1 Number of Periods per Week for Practical Work

Table 4.23 shows how many lessons per week practical work was incorporated in the school.

Table 4.23

Number of Periods per Week for Practical Work

	Students		**Teachers**	
	f	%	*f*	%
3 lessons	24	22.8	2	12.5
2 lessons	28	31.6	7	75.5
1 lesson	28	31.6		
Others	8	14.0	2	12.5
Total	**87**	**100**	**11**	**100**

As shown on Table 4.23 schools differed on the number of lessons per week they incorporate practical lessons. This further indicated that the practical work was of unequal importance to the schools.

4.6.2 Effect of Time Allocated for Practical Work on the Completion of Tasks

Table 4.24 shows the thoughts of the respondents on the effects of time allocated for practical work on the completion of tasks.

Table 4.24

Is the Allocated for Practical Work Enough for you to Complete Practical Tasks?

	Students		**Teachers**	
	f	%	*f*	%
Yes	45	52.6	7	62.5
No	42	47.4	4	37.5
Total	**87**	**100**	**11**	**100**

According to Table 4.24 majority of the respondents acknowledged that the time allocated for practical tasks in the schools was enough for them to carry out and complete the practical work. Yet some still felt that there is need to extend the time since sometimes they have to stop practical work to attend the next class.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This chapter looked at the summary of the entire study as well as the conclusions arrived at and the recommendations to the various stakeholders with regard to biology practical work and the teaching and learning of biology.

5.1 Summary of the Study

This study investigated the influence of practical work on the mastery of Biology in public secondary schools in Dagoretti Sub-County, Nairobi County. The study found that practical work has a robust influence on the teaching and learning of Biology and that the degree of influence varied from student to student and from one teacher to another. The study further indicated that the degree of influence of practical work on the teaching and learning of Biology further depended on some factors. Firstly, it is the attitude of teachers and students towards practical work. It was noted that students and teachers generally have a positive attitude towards practical work although part of the students showed a general lack of understanding regarding the relationship between practical work in Biology and theory. This is likely to affect students' view and commitment to practical work thereby affecting the teaching and learning of biology.

Secondly the study showed that the degree of influence also depends on the skills that teachers emphasize during practical work wherein it was noted that teachers tend to emphasize more of basic process skills like manipulation of equipment than integrated process skills like hypothesis formulation. This also affects students' notion of practical work and thus the teaching and learning of Biology.

The study also showed that the influence of practical work relies on the quality and adequacy of laboratory materials and resources available. It was a point of note that in as much as the time allocated for practical work seemingly was enough to carry out practical exercises, the students and the teachers demanded for more. However, though the schools possess well equipped laboratories, they are generally used for more than one subject which is also a contributing factor to students' view on practical work and consequently affecting the teaching and learning of the subject.

5.2 Conclusions

Based on the objectives of the study, the researcher drew the following conclusions from the findings;

In science, and Biology in particular, a laboratory is a key resource in the teaching and learning. However, for it to play an effective role it must be well equipped and used for its particular function. The researcher noted on the one hand that time and equipment were available for the schools' laboratories but on the other hand one laboratory served for two subjects and sometimes even for all the subjects. Biology is meant to teach both basic process skills and integrated process skills yet according to the findings of this study, basic process skills such as manipulation of equipment and making observations were emphasized over integrated process skills such as hypothesis formulation. Furthermore, the attitude of teachers and students towards biology practical work is generally positive however there is a tendency for students to see practical work as a separate entity from theory work or that one could replace the other instead of viewing both as two sides of the same coin or as dependent on each other. And lastly it showed

that the teachers have a good notion about the aims of practical work in biology given the fact that many agreed with the aims that were proposed in the questionnaire.

5.3 Recommendations

In a bid to increase and better the teaching and learning of biology through practical work in public schools not only in Nairobi County but in Kenya as a whole, the following are the recommendations;

1. Teachers need to make the students more aware of the roles theory and practical play as parts of a whole in the biology syllabus.
2. Schools need to allocate more time for practical lessons as this was the general demand from the students.
3. More laboratories need to be built so that one laboratory caters for one subject. This will help make teaching and learning better and more enjoyable for both students and teachers.
4. Curriculum developers need to clearly elaborate the aims of practical work especially those patterning to the skills that teachers need to emphasize in the teaching and learning of biology during biology practical work.

5.4 Suggestions for Further Research

The influence of practical work on the mastery of biology has been established in this study. However, the researcher proposes the following areas for which further research may be conducted;

1) A research may be carried out on the factors influencing students' performance in biology in national examinations such as KCSE.
2) This study noted on the one hand that there were more male science students than female but on the other hand, there were more female science teachers than male. Thus, a research could be carried out on the factors influencing students' carrier choice especially as science teachers.
3) Living in the twenty first century amidst modern technology, there is need to look into the influence of information and communications technology (ICT) on the teaching and learning of biology.

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APPENDIX I

QUESTIONNAIRE FOR TEACHERS

Marist International University College

Department of Education

P. O. Box 24450-00502

Nairobi- Kenya

Dear respondent,

Yao Aristide Ghislain is a student at Marist International University College undertaking a research on the influence of practical work on the mastery of the biology subject in selected secondary schools in Nairobi County. Your assistance in getting the information for the study is important. Kindly respond to the questions as honestly as possible because the information you will provide will be highly values and treated as confidential and only for academic purposes. I, therefore cordially invite you to answer the questions below without writing your name anywhere on this questionnaires.

Yours sincerely,

Yao Aristide Ghislain (B.Ed/400/14/15)

Section A: Demographic Information

Instruction: For the following items, please indicate your answer by ticking (√) in the square brackets [ ] provided.

1. Gender: Male [ ], Female [ ]
2. Working experience: Less than 5 years [ ], 5-10 years [ ], more than 10 years [ ]
3. Average size of the class you teach: 15-20 students [ ], 20-25 students [ ]
   25-30 students [ ], more than 30 students [ ]

Section B: The Influence of Students' Attitude towards Practical Work on the Teaching and Learning of Biology

Below are statements regarding practical work in biology with letters A (Agree), U (Undecided) and D (Disagree) against each statement. The researcher is interested in knowing how you feel about each statement. Respond by ticking (√) in the column with the most appropriate letter depending on how you feel about each statement. There is no right or wrong answers. Just give your views freely and honestly

	Statement	**A**	**U**	**D**
1	Practical work in biology helps students acquire skills in doing experiments			
2	The biology teacher should carry out activities in practical work while the students sit back and watch			
3	Students should help the teacher when s/he is demonstrating an experiment			
4	Practical makes it possible for students to learn biology while using all their senses			
5	Practical work makes the learning of biology more difficult			
6	There should be continuous assessment for biology practical work which should be included in the final results			

7	Practical work in biology is too demanding for the students			

Section C: The Attitude of Teachers towards Teaching Biology Practical Work

Below are statements concerning the teaching of biology practical work with letters A (Agree), U (Undecided) and D (Disagree) against each statement. The researcher wishes to know how you feel about each statement. Respond by ticking (√) in the column with the most appropriate letter(s) depending on how you feel about each statement. There is no right or wrong answers. Just give your views freely and honestly

	Statement	**A**	**U**	**D**
1	The biology teacher should help students in practical work only when they get stuck			
2	The biology teacher does not help students to design investigations aimed at solving problems related to biology			
3	Skills gained during practical lessons are more important than just getting the right answers			
4	We cannot make new discoveries in science without practical work			
5	During practical lessons students should check if what they do in theory is true			
6	Teaching practical work is very enjoyable			

Section D: The Opinions of Teachers and Students towards the Aims of Biology Practical Work

The following are some of the laboratory aims for practical work in biology with letters A (Agree), U (Undecided) and D (Disagree) against each statement. To what extend would you say these statements are true for biology practical work lessons? Indicate your responses by ticking (√) in the appropriate column, the way you feel about the aims

Practical work in Biology in secondary schools is meant:

	AIM	A	U	D
1	To teach basic practical skills			
2	To familiarize students with standard apparatus and measuring techniques			
3	To train students in making observations			
4	To train students on recording observations			
5	To train students in making deductions and interpretations of experimental data			
6	To use experimental data to solve specific problems			
7	To train students on writing reports of experiments			
8	To train students in simple aspects of experimental design			
9	To arouse and maintain students' interest in the subject			
10	To show the use of practical work as a process of discovery			
11	To verify scientific facts			
12	To help bridge theory and practice			
13	To train students on how to raise and answer questions on scientific phenomena			
14	To train students on hypothesis formulation			

Section E:

I --The Contributions of Practical Work towards the Improvement of Students' Mastery of the Biology Subject

1. Does practical work improve students' interest in learning biology? Yes [ ] or No [ ]

2. Explain your answer

……

……

II--The Influence of the Quality of Laboratory Materials on the Learning of Biology Practical

1. How many Laboratories does your school have?

One Lab for each of the three science subjects (Bio, Chem, Phy) [ ]

Two Labs for the three science subjects (Bio, Chem, Phy) [ ]

One Lab for all the science subjects (Bio, Chem, Phy) [ ]

Others [ ]

2. If your answer is others, please specify

……

.....

Indicate below by ticking (√) in the appropriate column how you feel about this statement

3. The laboratory materials indicated below are available in our laboratory and are of good quality.

	Materials	**A**	**U**	**D**
i)	Benches			
ii)	Tap water			
iii)	Stools/chairs			
iv)	Equipment (pipette, burette, measuring cylinder etc)			
v)	Heating apparatus			

vi)	Functioning fume cupboard			
vii)	Chemicals			
viii)	First aid box			
ix)	Chemicals' store			

III--The Effects of Time allocated for Practical Work on the Teaching and Learning of Biology

1. How many periods per week per class do you incorporate practical lessons in Biology.

   Tick (√) appropriately

   3 lessons [ ], 2 lessons [ ], 1 lesson [ ], Others [ ]

2. If your answer is others, Please specify

……

3. Is the time allocated for practical lessons enough to complete practical tasks?

   Yes [ ] or No [ ]

4. Please explain

……

……

……

5. What could be done to improve practical lessons in your school?

……

……

……

APPENDIX II

QUESTIONNAIRE FOR STUDENTS

Marist International University College

Department of Education

P. O. Box 24450-00502

Nairobi- Kenya

Dear respondent,

Yao Aristide Ghislain is a student at Marist International University College, a constituent college of the Catholic University of Eastern Africa, undertaking a research on the influence of practical work on the mastery of the biology subject in selected secondary schools in Nairobi County. Your assistance in getting the information for the study is important. Kindly respond to the questions as honestly as possible because, the information you will provide will be highly valued and treated as confidential and used only for academic purposes. I, therefore cordially invite you to answer the questions below without writing your name anywhere on this questionnaires.

Yours sincerely,

Yao Aristide Ghislain (B.Ed/400/14/15)

Section A: Demographic Information

Instruction: For the following items, please indicate your answer by ticking (√) in the square brackets [ ] provided.

1. Gender: Male [ ], Female [ ]
2. Age: 12-15 years [ ], 16-20 years [ ], above 20 years [ ]

Section B: Influence of Students' Attitude towards Practical Work on the Teaching and Learning of Biology

Instruction: Below are statements regarding practical work in biology with letters A (Agree), U (Undecided) and D (Disagree) against each statement. The researcher is interested in knowing how you feel about each statement. Respond by ticking (√) in the column with the most appropriate letter depending on how you feel about each statement. There is no right or wrong answers. Just give your views freely and honestly

	Statement	**A**	**U**	**D**
1	Practical work in biology helps students acquire skills in doing experiments			
2	Practical makes it possible for students to learn biology while using all their senses			
3	Practical work makes the learning of biology more difficult			
5	Practical work in biology is too demanding for the students			
6	I prefer doing experiments by myself to watching the teacher perform them			
7	Practical work increases students' interest in learning biology			
8	I prefer reading my biology book to doing experiments			

Section C: Opinions of Teachers and Students towards the Aims of Biology Practical Work

Instruction: The following are some of the aims for practical work in biology with letters A (Agree), U (Undecided) and D (Disagree) against each statement. To what extent would you say these statements are true for biology practical work lessons? Indicate your responses by ticking (√) in the appropriate column, the way you feel about the aims of biology practical work

Practical work in biology in secondary schools is meant:

	AIM	A	U	D
1	To teach basic practical skills			
2	To familiarize students with standard apparatus and measuring techniques			
3	To train students in making observations			
4	To train students on recording observations			
5	To train students in making deductions and interpretations of experimental observation			
6	To use experimental data to solve specific problems			
7	To train students on writing reports of experiments			
8	To train students in simple aspects of experimental design			
9	To arouse and maintain students' interest in the subject			
10	To show the use of practical work as a process of discovery			
11	To verify scientific facts			
12	To help bridge theory and practice			
13	To train students on how to raise and answer questions on scientific phenomena			
14	To train students on hypothesis formulation			

Section D:

I -- Contributions of Practical Work towards the Improvement of Students' Mastery of the Biology Subject

Instruction: For the following item, please indicate your answer by ticking (√) in the square brackets [ ] provided.

1. Does practical work improve students' interest in learning biology? Yes [ ] or No [ ]
2. Please explain your answer

……

……

II-- Influence of the Quality of Laboratory Materials and Facilities on the Learning of Biology Practical

Instruction: Indicate your responses by ticking (√) in the appropriate square brackets [ ] provided.

1. How many Laboratories does your school have?

One Lab for each of the three science subjects (Bio, Chem, Phy) [ ]

Two Labs for the three science subjects (Bio, Chem, Phy) [ ]

One Lab for all the science subjects (Bio, Chem, Phy) [ ]

Others [ ]

2. If your answer is others, please specify

……

.....

Instruction: Indicate below by ticking (√) in the appropriate column how you feel about this statement

3. The laboratory materials and facilities indicated below are available in our laboratory and they are of good quality.

	Materials	**A**	**U**	**D**
i)	Benches			
ii)	Tap water			
iii)	Stools/chairs			
iv)	Equipment (pipette, burette, measuring cylinder etc)			
v)	Heating apparatus			
vi)	Functioning fume cupboard			
vii)	Chemicals			
viii)	First aid box			
ix)	Chemicals' store			

III--Effects of Time allocated for Practical Work on the Teaching and Learning of Biology

Instruction: For the following items, please indicate your answer by ticking (√) in the square brackets [ ] provided.

1. How many periods per week per class do you incorporate practical lessons in Biology.

   Tick (√) appropriately

   3 lessons [ ], 2 lessons [ ], 1 lesson [ ], others [ ]

2. If your answer is others, Please specify

……

3. Is the time allocated for practical lessons enough to complete practical tasks?

Yes [ ] or No [ ]

4. Please explain

……

……

……

5. What could be done to improve practical lessons in your school?

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……

……