EFFECT OF LABORATORY MANAGEMENT ON STUDENTS’ PERFORMANCE IN PHYSICS IN PUBLIC SECONDARY SCHOOLS IN BOMET COUNTY, KENYA

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MAY, 2017
DECLARATION

I declare that this project is my original work and has not been presented in any other university for consideration. This research project has been completed by referenced sources duly acknowledged. Where text, data (including spoken words), graphics, pictures or tables have been borrowed from other sources, including the internet, these are specifically accredited and references cited in accordance in line with anti-plagiarism regulations.

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DEDICATION

Special thanks to my dear parents for their humble ambition for me to go to school and excel in academics.
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I salute my supervisors, Prof. John Aluko Orodho and Dr. Madanji Gabriel for their effective guidance, studious readership and perpetual availability for consultation.
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ABBREVIATIONS AND ACRONYMS

APU  Assessment of Performance Unit
CDF  Constituency Development Fund
FDSE Free Day Secondary Education
GCSE General Certificate of Secondary Education
GNP  Gross Net Production
IIEP International Institute for Education Planning
IPST Institute for the Promotion of Teaching Science and Technology
MOE  Ministry of Education
NCERT National Council of Education Research and Training
SEPU Science Equipment Production Unit
SMASSE Strengthening Maths and Science in Secondary Education
SSC  Senior Secondary Certificate
UNCST Uganda National Council for Science and Technology
UNESCO United Nations Educational Scientific and Cultural Organization
ABSTRACT

The purpose of this study was to examine the effect of laboratory management on students’ performance in physics in public secondary schools in Bomet County, Kenya. The objectives of the study were: (i) to evaluate acquisition and utilization of physics laboratory resources on students’ performance in physics, (ii) to determine the efficiency of the schools’ laboratory safety measures in ensuring safety that is vital for students learning and performance in physics (iii) to establish challenges facing the secondary schools in management of physics’ laboratories and their effects on students’ performance in physics and finally (iv) develop strategies of improving physics’ laboratories management that boost students’ performance in physics. The research study employed a descriptive survey study design. The study was guided by Production Function Theory by Mace (2005). A total of 8 public secondary schools were randomly sampled for this study. With a target population of 74608, simple random sampling technique was used to select respondents including 8 Principals, 8 Heads of Science Department, 16 Physics Teachers, 8 laboratory technicians and 160 students, all samples totaling to 200 respondents. The researcher used questionnaires, interview schedules, and observation schedules to collect data. Data obtained was analyzed using Statistical Package for Social Sciences (SPSS) computer package. Responses from questionnaires, interview and observation schedules were organized according to objectives of the study. The findings are presented through descriptive statistics using frequencies, tables, graphs and pie-charts. Laboratory management issues that the study found to have had an effect on the performance of physics included lack of clear in-servicing programs for laboratory personnel, failure to accommodate practical in schools’ internal tests, lack of clear supervision of laboratory teaching/learning programs and failure to embrace participatory decision making in procurement of physics laboratory materials. It was concluded that the schools sampled lacked clear in-servicing programs for their laboratory personnel, practical skills are not tested in most schools’ internal tests, absence of clear supervision programs and failure to embrace participatory system in procurement of lab resources. Recommendation aimed at changing the learner’s attitude toward physics, inclusion of practical in internal schools’ evaluation tests, government to take over both the safety responsibility in schools and employment of laboratory technicians were arrived at. Areas recommended for further research are that similar research be done on private secondary schools, and studies on quality of programs offered to principals on laboratory management.
CHAPTER ONE

1.1 Introduction

This chapter presents the background to the study, statement of the problem, purpose of the study, objectives of the study, research questions, assumptions of the study, limitations and delimitations of the study, significance of the study, theoretical and conceptual framework and finally the operational definition of key terms.

1.2 Background to the Study

Practical work is a unique source of teaching and learning in any science subject because science students are able to observe and manipulate materials to demonstrate certain aspects of the subject matter which has been learnt in class through lectures, discussions and textbooks (Adeogun & Osifila, 2008). Science education literature articulates that laboratory work is an important medium for enhancing student’s attitudes, stimulating interest and enjoyment, and motivating students to learn. Physics is one of the three main science subjects that is majorly learnt through practical work. Practical work provides physics students with opportunities to engage in the processes of investigation and inquiry. UNCST (2007), as quoted by Rotich (2013), noted that practical experiments have been observed to be central to the teaching of science in that they help develop scientific investigation and motivates, creates curiosity, objectivity and willingness to evaluate evidence. This is the reason why availability and utilization of laboratories cannot be over emphasized. Practical work also gives students appreciation of the spirit and methods of problem solving, analytic and generalization ability (Adeyemi & Adu, 2010). For instance, DeBoer (2000) carried out a research on the effectiveness of individualized approach to general education science laboratory. Students reported
that personal laboratory work was the most effective instructional method for promoting their interest.

The core business of any school system is to deliver quality education and to ensure that pupils reach their potentials (Adeyemi & Adu, 2010). It is the responsibility of the school managers to ensure adequate provision, effective and efficient use of educational resources to meet the objectives of their institution (Okumbe, 2001). These educational resources, according to Adeogun and Osifila (2008), can be categorized into four groups that is human, material, physical and financial resources. Research has demonstrated that the quality of education depends primarily on the way these school resources are managed rather than on their abundance (World Bank, 2007).

According to Chiriswa (2003), science (Latin, scientia-meaning “knowledge) is defined as a systematic enterprise that builds and organizes knowledge in the form of testable explanation and prediction about the universe. It could also mean a body of knowledge itself, or the types that can be rationally explained and reliably applied. The application of science and its discoveries to solving human problems is known as technology. Science and technology has resulted in ultra-modern buildings, broad tarred roads, solid bridges, beautiful and well equipped stadia, industrial and commercial houses, emergence of nuclear energy, electronic and biological revolution and high degree of urbanization, and so on. The learning of physics in schools should be stressed because of its importance to national development (Maicibi, 2003).
Schools may be public or private, urban or rural. Irrespective of the type and location of school, Physics should be handled in such a way that students feel encouraged to like and enroll in physics. The way and manner in which the student operates in a physics laboratory class takes the form of observing, classifying measuring, hypothesizing, experimenting, interpreting data and making inference-integrated sciences, (NERDC). The student carries out his/her work in a special room called the laboratory. Such room is always stocked with materials the student or scientist works with. Piaget noted that when concrete materials are used by students they are able to solve problems which they are naturally limited to solve. There must be enough of these materials in schools for the students to perform well in physics (Otula, 2007).

The use of the laboratory as a method of teaching physics helps the students to develop manipulative skills. It leads to better retention of information and also development of favourable attitudes towards physics as a subject. The students during the use of a physics laboratory are active participants who acquire more knowledge by performing experiments. The method makes the students to become familiar with such mental processes as observing, inferring, classifying, measuring and data interpretation. Learning becomes interesting as a result of using concrete materials. This leads to better performance of physics among the students. The use of the laboratory also enhances good space management and teacher’s effectiveness. (Akinsolu, 2003).

If the physics laboratory is not in place or not stocked sufficiently with the apparatus, the physics teacher will not have enough materials to teach and guide the
students. Absence of these materials may affect students interest, enrolment and performance in physics; confirming what had been reported, that laboratories with inadequate materials have adversely affected performance in science in Taita, Taveta, Kenya (Yousuf & Ammed, 2005).

School laboratory is a very important educational resource for learning scientific knowledge and skills that require proper attention by the school management. Rich benefits in learning physics accrue from using laboratory activities. A physics laboratory should provide a learning environment in which students develop their understanding of scientific concepts in physics, inquiry skills and the general perception of physics. However, this is only realizable when proper management mechanisms are put in place to ensure that meaningful learning activities are going on well in a physics laboratory class lessons which make learning of physics stimulating, interesting, joyful and motivating to the learner.

According to Education Act (2013), a head teacher is responsible for overall management, control and maintenance of standards in the school and is accountable for all that happens in a school. A physics laboratory, as a subsystem of the school with all the four categories of educational resources: human, material, physical and financial resources, needs to be closely monitored to ensure that maximum benefits of learning physics are realized. The principal is seen as the first supervisor in ensuring that meaningful teaching and learning activities are taking place in a physics laboratory class lesson because he/she has to play the leader in checking the teachers’ classroom work and assessing the overall learner’s performance (Republic of Kenya, 2013).
Hodson (2009) noted mismatch between teacher’s rhetoric and practice in teaching of sciences such that although their articulated philosophies appeared to support an investigative, hands-on, mind-on approach with authentic learning experiences, the classroom practice of those teachers did not generally appear to be consistent with their stated philosophies. This leads to low performance in sciences which contributes eventually to development of general negative attitudes towards sciences because of the general perception that sciences are hard. Barchok (2008) noted that, generally, the results from the Kenya certificate of secondary examination indicated that sciences continued to be poorly performed compared to other subjects. He attributed the poor performance of science in Bomet District to unfavorable attitudes held by students towards science subjects. He remarked that the factors that influence the formation of attitudes in science need to be understood in an endeavor to foster development of favorable attitudes in students.

The effect of using laboratories in teaching and learning of physics and the other sciences in general is that students tend to understand and recall what they see than what they hear or were told. Therefore, the laboratory is essential to the teaching of physics and the success of students in performance in physics is much dependent on the laboratory provision made for it. A physics Laboratory, therefore, occupies a central position in the teaching and learning of physics. However, many studies have established that physical and material resources in most secondary schools in Kenya are inadequate. This research will partly look at these issues of laboratory class supervision and the adequacy of physics laboratory resources in secondary schools in Bomet County. The study also intends to see the extent to which head teachers manage the available human and physical laboratory resources in their schools and
how they take up their task of overseeing whether the laboratory activities are on course in meeting the learning objectives in Bomet County.

The situation in Bomet District is that students interest and enrolment in physics appears to be declining year after year, a situation which if not checked can mar the technological development of this nation. Therefore, this study seeks to appraise physics laboratories and laboratory equipment in Bomet County.

1.3 Statement of the Problem

A physics laboratory should provide a learning environment in which students develop their understanding of scientific concepts in physics, inquiry skills and perception of physics as an equally important subject in our country’s economic development. Unfortunately, in most secondary schools, students have negative attitude towards physics (Barchok, 2008); their enrollment in physics subject has been persistently low because they find learning of physics not stimulating, not interesting and joyful and motivating (Rotich, 2013).

The 2013 KCSE analysis of Bomet County shows that out of the 20 subjects that the candidates sat for, physics was position 17. In that year, the subject had a mean of 4.691 with an entry of 3669 out of the 9326 candidates who sat for the exam. The leading subject had a mean of 10.80 (Bomet County K.C.S. E 2013 exams analysis summary, 2014). This results are worrying because for health assurance the county needs personnel who can handle health machines such as dialysis equipment, x-rays machines and several other technological machines used for treatment in hospitals. We need engineers, pharmacists, laboratory technicians, pilots, civil engineers and so forth for economic growth in the county. Bomet County must be seen to move
with the other parts of our country towards the achievement of the vision 2030 which places science subjects as playing a central role towards this vision. If schools would properly manage their physics laboratories the overall mean grade in physics subject possibly can be above 6.0, the average mark in K.C.S.E examination.

Research results by Ajaja (2005) have shown that physics teachers continue to teach physics using the lecture method despite recommended guided discovery methods. According to Ajaja (2009) the inability of physics teachers to apply guided discovery inquiry approaches in their teaching is hinged on lack of laboratory equipment among others. According to Fakoya (2002) under-funding had adverse effects on the quality educational resources in secondary schools. It is against this background that this study was necessary to assess whether school heads in Bomet secondary schools allocate enough funds for purchase of adequate laboratory chemicals and equipment and ensure their effective use. The challenges faced in the schools’ physics laboratories are also analysed alongside the suggested possible remedies to these challenges.

1.4 Purpose of the Study

The purpose of the study was to examine the effect of laboratory management on students’ performance in physics in public secondary schools in Bomet County, Kenya.
1.5 Objectives of the Study

The study sought to:

1. Establish the mechanisms that the principals in Bomet County have put in place to ensure adequacy, effective and efficient utilization of physics laboratory resources and the effects of the mechanisms on students’ performance in physics.

2. Determine the efficiency and effectiveness of the schools’ laboratory safety measures in creating a secure physics learning environment in Bomet County.

3. Evaluate the challenges facing the secondary schools in management of physics laboratories and their relation to students’ performance in physics in Bomet County.

4. Develop strategies of improving laboratories management that boost students’ academic performance of physics in Bomet County.

1.6 Research Questions

1. What mechanisms have the principals in Bomet County put in place to ensure
   a) Procurement of adequate physics laboratory resources?
   b) Efficient and effective utilization of available physics laboratory resources in meeting the specific learning objectives in a physics class?

2. What are the efficiencies and effectiveness of the schools’ laboratory safety measures in case of occurrence of a major accident in the laboratory in Bomet County?

3. What are the challenges facing the secondary schools in management of physics laboratories in Bomet County?

4. What strategies can be put in place for improving management of physics laboratories so as to boost students’ performance in physics in Bomet County?
1.7 **Significance of the Study**

The study of laboratory management provides information that is useful in:

- analyzing the situation of our laboratories, determining whether the laboratory facilities provided through parents and government funding are well utilized;
- identifying problem facing learning of physics in our school laboratories and finding appropriate solutions;
- ensuring all physics laboratory activities are carried out properly by the right people and in time;
- using the lessons learnt from the study of Bomet physics laboratory situations on to other counties.

1.8 **Limitations and Delimitations of the study**

1.8.1 **Limitations of the Study**

According to Orodho (2012), limitations are conditions beyond the control of the researcher that may place restrictions on the conclusions of the study and their application to other similar situations. In the study the following three limitations might have had affects on the research findings and thereby the conclusion:

a) The study relied mainly on three methods of data collection which are questionnaires, interview and observation schedules which might not have sufficiently and exhaustively probed the issues that the research sought to study.

b) Some of the respondents, especially those employed by the school board of management and students, might not have provided very accurate information because such things as fear of job security or peer interference while answering the questionnaires.

c) The study could not be able to control the attitudes of the respondents hence could affect the validity.
1.8.2 Delimitations of the Study

According to Mugenda and Mugenda (2003), delimitations are boundaries of the study. This study focused on Bomet County. In Bomet County there are a total of 168 public secondary schools and 7 private secondary schools.

a) The research study considered only the public secondary schools.

b) The research also concentrated only on Principals, Heads of Science Department, physics teachers, Students and Laboratory Technicians.

c) Due to time, financial implications and problem of accessibility to all the schools, 8 public secondary schools were selected to represent the various Sub-Counties in Bomet, with almost equal number of boys, girls mixed secondary schools; provincials and district schools.

1.9 Assumptions of the Study

The study was guided by the following assumptions:

1. The respondents would provide independent and accurate information as per the item in the questionnaire.

2. The performance of physics in the school had no external influence other than the teaching/learning gained through the school system i.e. there were no cases of exam cheating.

3. The sampled schools are representative of the target population.

4. All schools in Bomet County have laboratories.

1.10 Theoretical Framework

The study was guided by Production Function Theory by Mace (2005). It’s worth distinguishing the terms efficiency and productivity to get a better perception of the
theory. Efficiency is used to describe amount of effort that it takes to accomplish a task. Productivity on the other hand is a measure of how much work is done in a particular time. Cohen et. al. (2003) define productivity as measuring performance of a firm which converts inputs into outputs. For instance, a firm uses inputs (materials, labor and capital) to produce outputs. Performance of a factory can be defined as productivity ratio of inputs into outputs where larger values are associated with good performance.

In this context, education is viewed as a productive activity that aims at minimizing set of inputs for a given set of outputs or maximization of outputs for a given set of inputs (Oyetunyi, 2006). Inputs include teaching and non-teaching staff, teaching-learning materials and buildings whereas outputs are graduates of any educational level. However, it’s difficult to measure inputs and outputs and quantifying them.

As regards inputs, non-school factors like home background, socio-economic status and student time influence the outcome, yet the theory ignores this. It’ll be difficult to measure outputs since the school has diverse functions that make education output a multiproduct of direct and indirect output (Gravenir & Gatimu, 2004). In most cases, examination achievements and the number of students completing a level has been perceived as output measures of schools. This study will use examination achievement to establish if the existing inputs (laboratory management) are used to produce maximum output with a view to determine existence or nonexistence of wastage in the system.

According to Psacharopoulos (2005) the efficiency of an education system can be analyzed from external and internal point of view. Internal efficiency relates to what
happens in the system, also refers to the intake and turn of students, possible wastage owing to poor management in laboratories on the system at various levels and capacity of utilization of resources so that for a given number of input the number of students can be determined. On the other hand, External efficiency links the system with qualitative manpower needs of the economic system to meet the needs of the economy. Internal efficiency uses measurability and analytical clarity as tools of educational diagnosis.

The production function is applied to measure education efficiency and productivity as though education is a manufacturing enterprise which is producing and imparting knowledge, skills and attitude to the labor force to serve the industry and other sectors of the economy-schools, Primary schools, secondary schools, colleges and Universities are considered as units of the industry, producing outputs who are graduates of educational system at all levels. All organizations (schools) need clear aims and objectives which will determine the nature of inputs (better laboratories management), the series of activities to achieve outputs (better performance and learned graduates) and the realizations of organizational (schools) goals. Feedback about the performance of the system and the effects of its operations on the environment are measured in terms of achieving the aims and objectives. Basic principles of organization and management apply in any series of activities in any organization. The common elements of management planning, organizing, directing, coordinating and controlling (management of laboratories) apply in all cases. These essential administrative functions must be carried out in all types of organizations.
While general principles and prescriptions apply to all organizations, differences in their aims and objectives influences the input – conversions – output process and is the series of activities involved in this process. The nature of inputs, the conversion process, and the forms of outputs will emphasize characteristic features of a particular organization. These features highlight alternative forms of structure, management methods of operations, and behavior of people employed by or working in different types of organizations. This theory will be relevant in this study in that it supports an efficient system (better management of laboratories in school as an organization) where inputs and outputs must balance and objectives realized.

1.11 Conceptual Framework

According to Orodho (2009), a conceptual framework is a model of presentation where a researcher conceptualizes or represents the relationships between variables in the study and shows the relationship graphically or diagrammatically. Figure 1.1 below shows the interaction between the laboratory management practices and the learning outcomes.
Figure 1.1: A Conceptual Framework on Laboratory Management and Students’ Performance in physics

**Laboratory management**
- Adequacy of laboratory equipment
- Frequency of laboratory activities
- Supervision of laboratory classes
- In-service of lab personnel
- Lab safety
- Lab maintenance
- Safety measures

**Students’ performance in physics**
- Practical skills
- Good grades in K.C.S.E physics exams
- Positive attitudes in students towards physics

**Extraneous moderating:**
- Teachers ability
- Competence of lab technician
- Availability of complementary learning resources e.g. books, audio-visuals, e.t.c
- Learners entry behaviour

**Source:** Modified from Orodho, (2012).

In the conceptual frame work the researcher has identified the laboratory management as an independent variable. Laboratory management includes acquisition of laboratory resources, ensuring appropriate frequency of utilization of laboratory, effective supervision of laboratory classes, laboratory organization and putting sound measures of ensuring safety in laboratories; The dependent variable as the students ‘performance in physics, because good performance in physics results from the effectiveness of laboratory management under the headship of the head
teacher; and finally extraneous moderating as the teachers ability, competence of laboratory technician, availability of other complementary learning resources such as books, charts, audio-visuals, e.t.c.

As earlier discussed under the theoretical framework, the education efficiency in imparting physics knowledge, practical skills and attitudes to the learners that they will apply into the labour market thereafter depends on a great extent on how physics laboratories are managed so as to yield maximum benefits to the learner. Good performance by learners in physics’ KCSE examination is one among the many indicators of a well managed laboratory system.

1.12 Definition of Significant Terms

The study uses the following key terms in the literature;

**Head teacher** the senior most staff in a secondary school charged with the responsibility of management, leadership and supervision of all activities and functions in the school

**Management** management as a method where a group of people at the highest level of organization plan, organize, communicate, control and direct the actions and activities of people who work for the organization towards the achievement of the organizational goals.

**Performance** an achievement or action as regards educational matters.

**Science** the three main science subjects namely: chemistry, biology and physics offered in secondary school curriculum.
CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

This chapter presents a review of literature related to the study. The literature is guided by the objectives of the study. The review focuses on what other researchers, scholars and educationists have said on adequacy and efficient utilization laboratory resources, mechanism for determining the effectiveness and efficiency of laboratories activities, safety measures of laboratory management in secondary schools, challenges facing the management of laboratories in schools and strategic management of laboratories in schools.

2.2 Acquisition and Utilization of Laboratory Resources on Students’ Performance

The first Objective concerns the acquisition of adequate physics’ laboratory resources and their effective utilization on students’ performance in physics. The objective has been analysed in three different areas namely: procurement of the physics’ resources, frequency of physics’ laboratory activities and supervision of physics’ laboratory activities.

2.2.1 Procurement of Adequate Laboratory Resources

According to Yousuf and Ammen (2005), the educational experience involving the learner actively participating in concrete examples are retained longer than abstract experiences. Further according to Adeoye and Papoola (2011), for learning to take place, learners must have access to necessary information materials and resources. They have to interact with tangible and intangible resources to ensure some level of
performance. Learner-centered hands-on activities are therefore an integral component in learning sciences. The student carries out his work in a special room called the laboratory. Such room is always stocked with materials the student or scientist works with. Piaget noted that when concrete materials are used by students they are able to solve problems which they are naturally limited to solve. There must be enough of these materials in schools for the students to perform well in science (Rebore, 2004).

If the laboratory is not in place or not stocked with the apparatus, the science teacher will not have materials to teach and guide the students. Absence of these materials may affect students interest, enrolment and performance in science; confirming what Lunetta (2007) had reported, that laboratories with inadequate materials have adversely affected performance in science in Taita, Taveta, Kenya. Notwithstanding, researchers have found shortages in the number of laboratories in Nigerian schools (Speering & Rennie, 2013). They argued that many schools do not have required laboratory facilities. Hence, students often fail to acquire science laboratory skills because their teachers were unable to conduct practical as they would like to and this always had inevitable consequences for students’ learning (Tytler, 2010). These shortages of laboratory facilities could have serious implications on the quality of schools’ output. All these show the importance attached to science laboratories in schools. It is this importance that prompted the researcher to examine the number of science laboratories in secondary schools in Ondo State, Nigeria and their influence on the quality of output in terms of students’ performance in the Senior Secondary Certificate (SSC) examinations.
Ogunniyi (2009) notes that there is a need to redefine the role of laboratory instruction in all countries. Given the poor utilization of laboratory facilities and equipment in many countries, it is a waste of time and effort to continue to support the construction and provision of traditional laboratory facilities without a very careful review of proposed projects prior to funding. For example, there should be a known relationship between equipment requested and specific curriculum objectives; equipment lists should be developed by educators familiar with the curriculum; and teachers should attend workshops on how to use the equipment. Adoye and Popoola (2011) examined teacher provision in the sciences in many countries and found that 45% of the schools surveyed indicated insufficient laboratories. His findings agreed with Hellriegel (2009) findings in Saudi Arabia which indicated inadequacy in the provision of laboratory facilities in schools. The findings were also consistent with those of Okumbe (2009) who found in Uganda that science education is faced with the problem of lack of resources with half the schools having no real laboratory.

Akinsanya (2010) argues that low-cost equipment of a sufficiently high standard for use in school laboratories can be produced locally. Only rarely should it be necessary to import equipment because it is cheaper than local equipment. If expensive equipment cannot be produced locally, then there is need for both an educational and a management study to be conducted to find out why. There are no sound pedagogical or financial reasons why extensive and sophisticated instrumentation should be purchased for demonstration purposes only. Some of the obstacles militating against effective science practicals include: lack of funds and the teachers’ inability to improvise. He also reported that there were no qualified
teachers for the subject as well as non-availability of record books for the equipment and materials stocked in the laboratory.

There is a need to analyze country-by-country and course-by-course basis, the cost-savings possible through maximizing the use of low-cost equipment. Given the extraordinarily high costs of traditional equipment, this study could encourage many more countries to explore the low-cost option than do at present (Mapaderum, 2012).

National Research Council (2006) observes that teachers do not have the time to make simple equipment themselves and should not, routinely, be expected to do so. However, teachers do need to be able to repair the equipment they have; workshops should be provided to give them the simple maintenance skills necessary. If a system uses laboratory technicians then they should receive equipment maintenance training. Ogunniyi (2009) and Maicibi (2003) concluded that practical work was difficult to organize as a result of lack of apparatus. Akinsanya (2010) from her study on the availability and adequacy of resources for science teaching in Kwara State, reported lack of adequate equipment most especially in the new schools. She also reported lack of improvisation of laboratory materials and equipment by the teachers. Tobin (2007) surveyed resources for science teaching in former Ilorin, Oyo and Bunu-Kabba of Kwara State. He reported that urban schools, had more science equipment than rural schools. He also reported that schools in urban areas improvised more than rural schools. Otula (2007) and Chandon (2003) studied the provision of laboratory safety equipment and materials and laboratory management practices in Ilorin and Oyi LGAs respectively. National Research Council (2000) found that 66.7% of target schools had laboratories for the three major science
subjects. Also, 80.9% of the schools had sinks, 71.4% had water taps, 33.3% had single multi-purpose laboratories, 50% of the sampled schools had all the standard contents of a first aid box. Ajaja (2005) found that 37.7% of the respondents reported having insufficient laboratory equipment and materials to go round the students during practicals. Furthermore, 58.9% of the respondents had inadequate supply of first aid materials for their school science laboratory. Oyetunyi (2006) investigated problems associated with science teaching in former Ifedapo LGA of Kwara State. She found that problems associated with practical work and laboratory equipment were rated fifth by the teachers and second by the students. She also reported poor management of laboratory equipment and materials.

Tytler (2010) reported either complete absence or gross inadequacy of equipment and materials in the sampled schools of former oyun LGA. Osaki et al (2004) investigated causes of students’ poor performance in chemistry practical in former okehi LGA. Sixty six point eight percent (66.8%) of the teachers and twenty eight percent (28%) of the students indicated that the laboratories were poorly equipped. Barchok (2008) study was conducted in Irepodun LGA. He found that many laboratories were ill-equipped and that practical work was done occasionally by students. Similar studies have not been carried out in Bomet County and therefore justify my study.

### 2.2.2 Frequency of Laboratory Activities

It is important for the head teacher to ensure that the teachers skills and knowledge, the teaching and learning resources, laboratory chemicals and equipment, the laboratory personnel are being utilized sufficiently for effective teaching and
learning. According to Omolo and Simatwa (2010), laboratory instruction is an important component of science learning and there should be proper government policies to ensure that practical scientific skills are learnt. Most countries do need to consider systemic reform but through deliberate and sustained evolution not revolution. However, Tobin (2007) confirms that the one issue which should be first addressed in most countries is the education of science teachers, especially their continuing education given the large number of unqualified young teachers now working in many systems. Teachers are the limiting determinant of reform in any classroom; they need support; they need recognition; and, most importantly, the profession is given due respect retained in some fashion.

Alternatively, West and Nelson (2011) confirm that laboratory skills should be included in examinations as part of a clearly defined, continuous assessment component, for which the classroom teacher is responsible and receives training. Ways will have to be found to safeguard the integrity of these examination results. These recommendations are not given in rank order unless so indicated, because it is not possible to define one set of priorities that would be appropriate for all developing countries. It is also not valid to rank these recommendations by a country's economic status, since many of the factors limiting successful secondary science achievement are country-specific not income-specific. For example, some very poor countries may have a larger percentage of well-qualified teachers than some relatively rich countries; it depends on their priorities in national budgets.

According to Chiriswa (2003), science (Latin, scientia-meaning “knowledge) is defined as a systematic enterprise that builds and organizes knowledge in the form
of testable explanation and prediction about the universe. It could also mean a body of knowledge itself, of the types that can be rationally explained and reliably applied. The application of science and its discoveries to solving human problems is known as technology. Science and technology has resulted in ultra modern buildings, broad tarred roads, solid bridges, beautiful and well equipped stadia, industrial and commercial houses, emergence of nuclear energy, electronic and biological revolution and high degree of urbanization, and so on. The learning of science in schools is being stressed because of its importance to national development. Schools may be public or private, urban or rural. Irrespective of the type and location of school, students are to be encouraged to like and enroll in science.

The way and manner the student operates takes the form of observing, classifying measuring, hypothesizing experimenting, interpreting data and making inference-integrated sciences, (NERDC). The use of the laboratory as a method of teaching science helps the students to develop manipulative skills. It leads to better retention of information and also development of favourable attitudes towards school subjects. The students during the use of laboratory are active participants who acquire more knowledge by performing experiments. The method makes the students to become familiar with such mental processes as observing, inferring, classifying, measuring and data interpretation. Learning becomes interesting as a result of using concrete materials. This leads to better performance among students. The use of the laboratory also enhances good space management and teacher’s effectiveness (National Research Council, 2010).
Researchers have found science laboratories to be central to the teaching of science in secondary schools (Leithwood, 2004). Laboratories have been found to be the scientists’ workshops where practical activities are conducted to enhance a meaningful learning of science concepts and theories (Hofstein, 2004). They have also been found to be a primary vehicle for promoting formal reasoning skills and students’ understanding, thereby enhancing desired learning outcomes in students (Kwan & Texley, 2003).

In respect of output, researchers have argued that output represents the immediate results of the system’s activities (Biehle & Motz, 2014). Their views supported Stephene et.al. (2005) remarks that education yields outputs which are the students that emanate at the end of the school programme. Their views also agreed with the arguments made by Barchok (2008) that output could be measured by the number of students completing a course, of standard length. The views also agreed with Oyetunyi (2006) contention that school output could be measured by assessing the rate of progress of students through an educational system as well as the performance of students in examinations at the terminal end of the school year.

In this regard, Hanushek (2003) measured output from secondary schools in terms of the number of school leavers weighted by the number of passes. According to him the quality of output is equated with students’ examination performance. His views were supported by Adeyemi and Adu (2010) who remarked that the best measure of output from secondary schools in Nigerian is the number of school leavers.

Osaki et al (2004) used practical work to foster students positive attitude towards and to arouse and maintain their interest in the learning of science subjects. Hudson
(2009) compared achievements of students taught by laboratory with those taught by lecture. He found out that students taught by laboratory methods achieved more acquiring scientific knowledge.

Tobin (2007) in his study on the status and quality of secondary science teaching and learning in Lagos state Nigeria, using quantitative and qualitative methods in collecting data where he surveyed 78 junior secondary school science teachers and 500 junior secondary students from three local Education District in Lagos state, coding and analyzing the data using the SPSS 13.0 statistical package to produce descriptive statistics came up with the following findings: There was a gap between actual science teaching learning and an ideal school science with regards to curriculum, Pedagogy and learning, class size and resource allocation, teacher knowledge and skills, attitude and professional development. He suggested recommendations for closing the gap. Similar study has not been done in Bomet County which justifies the study.

2.2.3 Mechanisms for Determining the Effectiveness and Efficiency of Laboratory Activities

Laboratory instruction is still considered an essential component of secondary school science classes in most countries. It is easy to suggest that problems associated with implementing the laboratory component of science classes result solely from inadequate facilities and a lack of equipment and supplies. If this were true, then simply providing facilities, equipment and materials, would solve these problems (Hofstein & Lunette, 2010). Many of these problems are, at least partly, a consequence of teacher insecurity with the subject matter, and a failure to include adequate teacher continuing education in implementation plans (Mobegi et al, 2010).
However too often, laboratories are used only as regular (expensive) rooms: equipment remains on the shelf unused to prevent breakage, or broken equipment remains unrepaired, consumable remains not resupplied; and teachers are not shown how to use and repair equipment (Chandon, 2003).

According to Mobegi, Omolo and Simatwa (2010), head teachers should take up their roles as quality assurance officers in their schools and ensure that there is adequate departmental supervision. They should introduce staff appraisal through locally designed forms to enhance standards and engage in evaluative class observation to ensure that a variety of teaching methods apart from class discussion is utilized. Rotich (2013) notes that schools with abundant resources not always utilize them efficiently and consequently fail to raise student’s level of performance. On the other hand schools with limited resources may utilize what they have efficiently and this may boost learning and students should be able to maximally utilize available resources so as to adequately achieve educational objectives. This is supported by Cohen et al (2003) who point out that it is not making resources available to schools that matters, but getting those resources to be used by teachers and students to get academic content learned.

With the government provision of educational resources through C.D.F and F.D.S.E funds, we can hypothesis that the poor performance could be partly due to shortage of or ineffective utilization of educational resources. Lydial & Nasongo (2006) observes that laboratory skills may, or may not, be included on the examination which is driving the curriculum. If laboratory work is not tested, it is probably not taught. There is also the issue of exactly what the objectives of Laboratory
instruction should be and how to achieve these objectives. There remains the unfilled need to reconnect the role of the laboratory in science instruction both for reasons of pedagogy and cost.

The study will endeavour to establish how school managers in Bomet County ensure high levels of learners’ involvement, interest and motivation in a laboratory class lesson. Without the productive efforts of workers, the material resources of an institution would be of no use. Furthermore, if the people who are in charge of these resources are not sufficiently qualified, then the utilization of these resources would not be optimal (Chandan, 2003).

2.3 Laboratory Safety Measures in Secondary Schools

Safety in the laboratory is an integral and indispensable component of the teaching and learning process during a laboratory class lesson. Indeed no meaningful teaching and learning can take place in an environment that is unsafe and insecure to both learners and staff. Mobegiet al (2010) as cited by Fraser (2012) reports that laboratories account for about 18% of accidents in school.

MOE Safety Standard Manual (ROK, 2008) give direction concerning safety in all educational institutions which must be adhered to ensure school safety. It is incumbent upon the school administrators who are the implementers of government policies to ensure that the MOE safety standards are not only adhered to but also fully implemented in every part of the school system to prevent occurrence of disasters in schools. Otula (2007) argues that the main aim of disaster preparedness is to set up appropriate systems and infrastructure for response in case disaster strikes. This includes laying down essential tools and procedures aimed at ensuring
operational readiness to combat calamities. Disaster preparedness minimizes the adverse effects of a disaster by ensuring a realistic level of pre-incident take up of risk reduction strategies as well as ensuring speed and timeliness in handling emergencies or disaster so as to minimize devastating effect.

Omolo and Simatwa (2010) investigated the implementation of safety policies in public schools in Kisumu East and West Districts, Kenya. The study established that some safety policies were implemented to lesser extent. The major findings of the study were that the MOE safety standards and guidelines had not been fully implemented majorly due to inadequate funds and inadequate supervision. The major recommendations therefore were policy makers to follow up, monitor and evaluate safety situation in all educational institutions and provide funds to all schools to enhance disaster preparedness. The available literature reveals that safety standards and guidelines had not been fully implemented in all schools by the management. Studies have been carried out under different topics on school safety in Kenya but none has been done on the implementation of safety standards and guidelines in laboratories in public secondary schools in Bomet County. This creates a knowledge gap in the area of how safety standards and guidelines are adhered to in laboratories in public secondary schools in Bomet County. Therefore the current study seeks to address this gap and give recommendations on what should be done to enhance school laboratory safety in order to secure the safety of learners, the personnel and laboratory resources and prevent occurrence of disasters in schools.

2.4 Challenges Facing the Management of Laboratories in Schools

According to World Bank (2007) the school management should endeavour to attract, retain, and motivate employees and maximally utilize their knowledge and
skills to effectively realize the schools’ objectives. For the better utilization of human resource in the schools, planning, recruitment and selection, training and appraisal of academic staff performance, their salaries, working conditions, and on-the-job training should be given proper attention by the school management. Therefore, in-service training for laboratory personnel and science teachers, among other human resource practices, is necessary for the school to maintain a skilled and knowledgeable staff (Rebore, 2004). My study seeks to find out what human resource management challenges that school managers in Bomet County face in their effort to ensure that maximum potentialities of laboratory personnel and science teachers are realized and properly utilized to achieve the schools’ objectives effectively and efficiently.

According to Akinsolu (2003), financial resource has been recognized as a major resource in the development of any education system because resources allotted for secondary education service delivery hinges on finances. The issue of finance is crucial to retention and the provision of quality education since it determines the quality of physical facilities, teaching and learning materials, quality of teacher motivation and teachers employed in the time of shortage (Mobegi et al., 2010). Mapederun (2012) emphasized that the availability and adequacy of educational resources affect the academic performance positively. Similarly, Chiriswa (2003) notes that effective teaching and learning depends on the availability of suitable adequate resources which enhance good performance in national examination. According to Fakoya (2002) under funding had adverse effects on the quality educational resources in secondary schools. Akinsanya (2010) commenting on educational resources says that they are important because the goal of any school
depends on adequate supply and utilization of physical and material resources among others as they enhance proper teaching and learning. This is the reason why this study is important.

2.5 Strategic Management of Laboratories in Schools

In the United Kingdom, the introduction of the General Certificate of Secondary Education (GCSE) has re-affirmed the importance of laboratory instruction in science (National Research Council, 2010). The teacher's guide for GCSE science states that the assessment of coursework by teachers can provide the best evidence of candidate's achievement in certain process areas of science. So, for example, coursework assessment maybe far more effective than timed, written papers where candidates are expected to show:

1. Research skills including the ability to select, organize and evaluate information from a wide range of sources.
2. The ability to design, conduct and report on investigations of various kinds.
3. The ability to review, evaluate and adapt methods of enquiry over a period of time.
4. The ability to make and record accurate observations in the laboratory or field.
5. Improved psycho-motor skills; including the safe manipulation of apparatus and handling of materials.

Rebore (2004) notes that since the GCSE was only introduced for the first time in 1988, problems associated with the continuous assessment of practical work are still being solved. The various examinations boards have interpreted the national criteria in different ways, resulting in some confusion. West and Nelson (2011) has
suggested that while the examination boards may not have defined laboratory skills” in sufficient enough detail to result in a technically valid assessment, they may have provided more detail than can be practically handled by teachers in the classroom.

Hofstein (2004) observes that there have been a number of attempts, especially in the United Kingdom, to produce a valid and reliable practical test (the Assessment of Performance Unit, APU, science surveys; the Techniques for the assessment of Practical Skills in Science Project; Warwick Process Science, the Graded Assessment in Science Project.) Such efforts have also been undertaken in Canada, and in the Netherlands. Doubts still persist about the reliability of practical assessment - as with many other forms of assessment - but there is research evidence that practicals do test some other component of knowledge than written tests (see, for example, the results of the APU science surveys).

Under the best of conditions with well-prepared teachers, laboratory instruction is problematic. In developing countries where there may be many unqualified science teachers, especially at the lower secondary level, there are more problems to consider. In many schools, there may not be a laboratory, equipment may be non-existent or in disrepair, there may be no electricity or running water in the schools, especially in rural areas; and, there may be no system in place to resupply consumable materials - or no money.

World Bank (2007) noted that the bulk of World Bank loans for secondary school science have supported the construction and equipping of laboratory facilities. Given the costs of building and equipping the traditional school laboratories and the uncertain benefit so for laboratory instructions especially as delivered by unqualified
teachers under unsatisfactory conditions much more attention needs to be paid to these.

modern hands-on science course can be successfully implemented in much simpler surroundings than is generally assumed- a large set-aside room, with sinks and running water, acid-resistant table tops, a source of electric current, locked storage space, and plenty of horizontal surfaces for display purposes etc., are probably all that are needed. Spirit burners may be used instead of gas. One non-negotiable (although frequently ignored) component of any laboratory, especially where chemicals are used, is construction for safety, and safety equipment. However, if hands-on chemistry is conducted at the micro-scale, it is probably safe to eliminate fume hoods (Tytler, 2010).

(Information on the range of laboratory techniques, now designated as micro-scale or small-scale chemistry, needs to be much more widely available than at present. This is one Instructional trend from the United States which should be very useful to all countries concerned with cost and safety says Osaki et al. (2004). Laboratories at the pre-university level do need to be more sophisticated in design - but, again, probably not as much as is assumed. Unfortunately, possession of a 'sophisticated' school laboratory is not only a status symbol, but its design can be based on memories of laboratory experiences of years gone by. Note that re-conceptualizing the laboratory experience in any country involves changing both the syllabus and the standardized examinations (Speering & Rennie, 2013).

The equipment and consumables with which laboratories are furnished also need to be carefully considered. It is obvious from the World Bank's experience in
supporting loans to purchase laboratory equipment that there is a need for an informed appraisal of all equipment ordered. Equipment that is too sophisticated for teachers to use or repair, is useless. Equipment used in school laboratories, especially at the upper secondary and tertiary levels, is expensive; it often has to be imported in developing countries. Instruments may be difficult to maintain in good condition, and spare-parts for repair may not be readily available; equipment may even be delivered already broken. In the schools, the teachers may be held accountable for all broken equipment, so there may be a real disincentive to use even the limited equipment that is available (UNESCO, 2009).

An alternative to the importation of expensive equipment, which may remain on the shelf, is the production of low-cost, locally made equipment, either by teachers and students in workshops, or at local production centers. There may even be learning advantages in using low-cost equipment. The equipment is often 'transparent,' i.e., it is simple enough in construction for students to understand how it works, and for teachers (and students) to repair if broken (Ogunniyi, 2009).

One concern related to the use of such equipment is the sense that it "isn't good enough' to produce acceptable quantitative results and, therefore, produces inferior learning. There is also a pride factor involved, as typified by the comment, We want our students to use real equipment. These concerns must be addressed. Some locally made equipment is of poor quality, and likely to fall apart easily (Okumbe, 2009). When teachers are not taught how to maintain equipment this is a particular problem -- not just in the case of locally made equipment, but for equipment from any source.
However, much (although not all) of the equipment now being produced locally is quite sufficiently accurate for the skills of the students, and the purposes of instruction, as well as being of sturdy construction. Most countries have to explore some way to reduce the costs of teaching the experimental sciences (Mapaderum, 2012). This is true for all sciences at all levels of instruction. All countries are potential purchasers of low-cost equipment. One example from the United States is the 'Bottle Biology' (i.e., biology experiments which uses two-liter soda bottles) project of the University of Wisconsin at Madison (UNESCO, 2009).

Hodson (2003) posits that there is an attempt to work with no cost' equipment necessary for many U.S. high schools. Hodson (2009) has run very successful workshops for teachers in Ethiopia, Ghana, and Tanzania also attempting the 'no cost approach to Laboratory instruction. It is suggested that teachers in developing countries have the time, or experience, to be able to construct much of their own equipment from locally available materials—all that is implied is that teachers need to be taught to use the local environment and natural phenomena, as part of 'hands-on' science. Maicibi (2003) confirms that locally produced equipment may not be low cost; in some instances it may be cheaper to import equipment from abroad. If this is the case, then there still remains the issue of who will maintain this equipment. One rationale for producing laboratory equipment locally must surely be the accompanying availability of trained technicians for maintenance. Another is the opportunity to provide maintenance workshops to teachers.

There is even some evidence that using kits to work around teachers tends to lower their morale (Stephene et al, 2005). It is always true that the introduction of new equipment, low or high cost, 'programmed' or otherwise should be accompanied by
teacher in-service workshops. There have been some very interesting approaches to
equipment design and manufacture utilizing teachers. For example, in 2006 in the
Philippines, the then Science Promotion Institute of the National Science and
Technology Authority held a competition among secondary school science teachers
to improvise science equipment for use in biology, chemistry, physics and general
science classes (Oyetunyi, 2006).

The Institute has also run workshops on the development of low-cost equipment for
college physics (National Research Council, 2010). Educational equipment
production centers are found in more than 40 countries including India (National
Council of Educational Research and Training - NCERT); Thailand (Institute for the
Promotion of Teaching Science and Technology - IPST); Kenya (Science Equipment
Production Unit - SEPU); Nigeria (Science Equipment Center); Brazil (Fundagao
Brasileirapara o Desenvolvimento do Ensino de Ciencias - FUNBEC); and
Venezuela (Centro Naconalpara el Mejoramiento de la Ensenanza de la Ciencia -
CENAMEC). Key factors which contribute to the success of an equipment
production center include: structured management; well-trained technicians;
professional designs; quality control; cooperation between centers, teachers and
curriculum developers; effective marketing and distribution; and production of
multi-purpose equipment to permit large production runs (and, hence, low per unit

The International Institute for Educational Planning survey mentioned previously
collected data on the costs of laboratory construction, and equipment and materials
purchase in 11 developing countries (Otula, 2007). The costs of constructing
laboratory facilities vary considerably from country to country, since the base cost
quoted may, in some cases, include only instruction and fittings and not the fixed furniture. There are also a range of costs possible within a country, with rural schools costing significantly more than urban schools in both Kenya and Botswana, especially if constructed with funds from a bilateral aid agency. According to the Institute study, constructing a school laboratory in a rural area in Kenya is 900 times more expensive if supported by foreign aid than by an association of parents (Tytler, 2010).

Generally, laboratories in lower secondary schools are less expensive than in upper secondary schools because the former tend to be simpler. This is not, however, the situation in Senegal, where costs are higher for lower secondary schools. Laboratories in the upper schools of Korea are more than twice as expensive as laboratories in Korean lower secondary schools (National Research Council, 2006).

The equipment costs cited were extremely high for most countries. Typically, biology equipment was more expensive than chemistry and physics, and costs were higher at the upper secondary level than at the lower. All of the countries surveyed imported all or most of the equipment used. It was reported that a fully installed and equipped physics laboratory in Botswana, Burkina Faso, Kenya, Morocco, Senegal, and Papua New Guinea costs from 117 to 145 times the per capita GNP. For Thailand and Korea this figure is 30 times the per capita GNP, in Jordan 19 times, and in Chile seven times. Given these costs, and the unproven benefits of laboratory instruction, it is not surprising that many are questioning the role of the secondary school laboratory (Lydial & Nasongo, 2006).
The low-cost equipment option certainly needs to be revisited. The literature on low-cost equipment tends to focus on how to make individual pieces of equipment, and how accurate specific examples of low-cost instruments can be. It tends not to be explicit on cost considerations except perhaps on an individual piece of equipment basis (Mapaderum, 2012). Depending on the piece of equipment, and the country involved, savings may range from 100% (the so-called no-cost option) to about 20% (see, for example T, Hulstrup and Waddington, 1983). Given the time limitations of this particular study, it was not possible to conduct a multi-national survey to collect data comparing the costs of traditionally 'low-cost' equipment on a country-by-country basis. This study is needed. Otula (2007) observes that there is also a danger that if practicals cannot be reliably tested then they will disappear, first from the examination and then the classroom. The arguments for and against laboratory-based instruction have tended to focus on the Piagetian framework of concrete versus formal operations. Given the experimental nature of scientific inquiry, and the motivational impact of laboratory work on the future scientist, the contribution of the laboratory to learning in science is a lot more complex than just illustrating the abstract.

UNESCO (2009) argues that it may now be necessary to redesign the traditional activities performed in school laboratories - or even to reconceptualize the content of laboratory instruction completely. In the United States, the introduction of small-scale chemistry is clearly associated with a re-evaluation of the importance of many classical chemistry experiments. As the focus of the curriculum moves away from science in the laboratory to science in the community, the laboratory activities of value in science instruction should also shift, especially at the lower secondary level.
The development of manipulative skills, and an ability to perform accurate measurements using simple equipment, are competencies transferable to adult life (science, and technology, for all).

At the upper secondary level, a facility in using instruments and techniques that are obsolete in the working world of science would appear to have little pedagogical value for either future citizens or future scientists. However, giving all students an opportunity to ask their own scientific questions, and design experiments using fairly simple equipment to answer these questions, does have value. The content of laboratory instruction for students in pre-university specialist courses must be revised in conjunction with university departments to ensure that students enter university prepared for the modern laboratory experience (Yousuf & Ammed, 2005).

Attempts to completely eliminate laboratory instruction in secondary schools should be strongly rejected. Requests to support the teaching of laboratory-based sciences as they were taught 20 years ago should also be rejected. At present, the use of low-cost equipment, where feasible, locally produced, must always be considered if both costs and pedagogy are to be taken into account. The Edutronics Group at the University of Delhi has demonstrated that it is possible to produce fairly sophisticated electronic equipment of a sufficient degree of precision to be used even in university instruction, at a relatively modest cost. There are many other successful models for production of such equipment in the developing world - it is both a tested, and an acceptable, solution (Chiriswa, 2003). A multi-national survey to collect data comparing the costs of traditional' versus 'low-cost equipment on a country-by-country basis could very persuasive in accelerating the acceptance of this
approach. This survey would also need to demonstrate that science instruction using such equipment was not, in any way, second class (Deboer, 2000).

There remain the issues of teacher comfort with laboratory instruction, teacher familiarity with modern instrumentation, and the capability of teachers to maintain equipment, or improvise from local materials. Teachers need more support than they are currently receiving in order to integrate meaningful, student-centered, laboratory-based activities into an intellectually coherent, modern science program. Unless teachers are better prepared to teach 'hands on/minds on' science, laboratory instruction will continue to be attacked as an expensive waste of time (Akinsanya, 2010). My study will seek to examine the frequency to which science teachers and laboratory technicians are in-serviced on effective utilization, improvisation and maintenance of laboratory equipment.
CHAPTER THREE
RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This chapter presents the various methods that were used in the study. Research design, study locale, target population, sampling technique and sample size, research instruments and their piloting, data collection techniques, methods of data analysis, logistical and ethical considerations will be discussed.

3.2 Research Design

A descriptive survey design was used for this study. Kothari (2008) describes research design as those studies which are concerned with describing characteristics to particular individuals or a group. Descriptive research is a process of collecting data in order to test a hypothesis or to answer questions concerning the current status of the objective of the study. Edmonds and Kennedy (2012) observes that this research design dictates how the variables are to be used in testing their relationship. Both qualitative and quantitative data analysis were used to find the relationship displayed by the variables.

3.3 Locale of the Study

The study was carried out in Bomet County. Bomet County borders with Narok County to the south, Nyamira to the west and Kericho County to the north. It is found in what was formerly called the Rift Valley Province. It is about 200km to the west of Nairobi.
3.4 Target Population

The target population was the head teachers, heads of department (science), physics teachers, and laboratory technicians from the 8 public secondary schools from Bomet County. The school selection was as follows in table 3.1.

Table 3.1: Sample Schools

<table>
<thead>
<tr>
<th>Schools</th>
<th>Bomet East</th>
<th>Bomet Central</th>
<th>Konoin</th>
<th>Chepalungu</th>
</tr>
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<tbody>
<tr>
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<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Boys</td>
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<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Girls</td>
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<td>1</td>
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<td>1</td>
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</tr>
</tbody>
</table>

3.5 Sampling Techniques and Sample Size

3.5.1 Sampling Techniques

Watson (2001) observes that due to the limitations of time, funds and energy, a study can be carried out from a carefully selected sample to represent the entire population. Kumar (2010) further outlines that for a small population, a sample size of at least 20% is a good representation while for a large population and a sample size of 10% is representative enough. Simple random sampling was used in sampling from 168 schools since it's the simplest technique with random sampling variants and also due to the anticipated structure of the population. Therefore, a total of 8 schools were involved in the study.
3.5.2 Sample Size

The respondents sample size is summarized in Table 3.2 below:

Table 3.2: Sampled Respondents from Target Population

<table>
<thead>
<tr>
<th>Respondents</th>
<th>Target Population (N)</th>
<th>Sample size (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head Teachers</td>
<td>168</td>
<td>8</td>
</tr>
<tr>
<td>HOD Science</td>
<td>168</td>
<td>8</td>
</tr>
<tr>
<td>Science Teachers</td>
<td>504</td>
<td>16</td>
</tr>
<tr>
<td>Laboratory Technicians</td>
<td>168</td>
<td>8</td>
</tr>
<tr>
<td>students</td>
<td>73600</td>
<td>160</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>74608</strong></td>
<td><strong>200</strong></td>
</tr>
</tbody>
</table>

Source: Researcher, 2015

3.6 Research Instruments

Because of the literacy level and age of the respondents participating in the study this research, therefore, employed the following research instruments:- questionnaires, interview schedules and observation schedules.

3.6.1 Questionnaires

The researcher uses the questionnaire to obtain factual data and opinions in a structured framework from the respondents. Kombo and Tromp (2006) state that a questionnaire is a research tool that can be used to collect data over a large group of subjects within a very short time. It also allows the researcher to collect large amounts of data in a relatively short amount of time (Gay et al, 2009). The questionnaires enabled the researcher to collect data on the influence of laboratory management on student performance of physics in KCSE examinations in BOMET.
County. Different questionnaires targeting the Heads of Department (Science), physics teachers and laboratory technicians were used.

3.6.2 Interview Schedules

Interview schedules is a method where the investigation follows a rigid procedure and seeks answers to a set of pre-conceived questions through personal interviews (Orodho, 2012). The selection of this method was based on the fact that principals are more busy and as such might not have time to answer to the questionnaires in good time.

3.6.3 Document Analysis

Document relevant to the study such as inventory records assisted in studying on maintenance and availability of the laboratory apparatus.

3.6.4 Observation Schedules

Observations from strategic points during a laboratory activity lesson was undertaken to see the degree of motivation and the level of learner’s interest in the physics laboratory class lesson.

3.7 Piloting of Research Instruments

Questionnaires were piloted in two secondary schools which were not to be involved in the actual study. According to Orodho (2012) piloting enables the researcher to find out if the questions are measuring what they are supposed to measure, if the wording is clear and if all the questions are interpreted in the same way by the respondents. For the purpose of this study, two respondents from each category who
were not to be involved in the main study were selected for the purpose of piloting through purposive sampling.

3.7.1 Validity of Instruments
Kothari (2008) emphasize that validity is the degree to which results obtained from the analysis of data represent the phenomenon under the study. The research instruments will be able to depict what they are measuring and what they are supposed to measure. Therefore, for the purpose of this study the supervisors’ expertise was sought so as to determine the relevance of the content used in the questionnaire.

3.7.2 Reliability of Instruments
The essence of reliability of the research instruments is to address consistency of results through repeated trials. Edmonds and Kennedy (2012) say that reliability is a measure to which a research instrument yields consistent data after repeated trials. The responses were analyzed after which one week period was allowed to pass before the same treatment was applied to the same respondents and analysis done. The Pearson Product-Moment Correlation Coefficient formula given below was used to calculate the Correlation Co-efficient in which: the (X) values were the data points that were generated from the number of respondents of corresponding questions for the first trial and the (Y) values were the data points obtained in the second trial. A correlation coefficient of +0.68 was obtained which indicated a perfect relationship between the first and the second results.

\[
r = \frac{n (\sum xy) - (\sum x)(\sum y)}{\sqrt{n(\sum x^2 - (\sum x)^2)(n\sum y^2 - (\sum y)^2)}}
\]
Where: \( \sum_{XY} \) = Sum of the gross products of the values of variables X and Y  
\((\sum X)(\sum Y)\) = Product of the sum of X and the sum of Y  
\(\sum\) = Sigma (meaning sum of) sum of the values obtained in piloting  
\(\sum X^2\) = Sum of squared values of X  
\(\sum Y^2\) = Sum of squared values of Y

3.8 Data Collection Procedure

The location of study was Bomet. Data were collected from a total sample size of 1008 respondents. To ensure efficiency, data collection was done in phases as follows:

Phase 1: A research permit to conduct the research was obtained from the National Commission for Science & Technology after obtaining consent from the following in Kenyatta University: Department of Educational Management, Policy and Curriculum Studies, Graduate School, Bureau of Research Directorate and Vice-Chancellor.

Phase 2: Appropriate copies of the research instruments were made and distributed to the sampled schools through research assistants.

Phase 3: Piloting was conducted with a small representative sample. Pre-testing was done so as to help ascertain if the selected questions were answering what they were supposed to measure.

Phase 4: Appointments were booked with the respective respondents.

Phase 5: At the end of data collection, the research assistants summarized the completed questionnaires and observation schedules. All the research data were pulled together for analysis.
3.9   Methods of Data Analysis

Data analysis is a process of inspecting, cleaning, transforming and modeling data with the goal of highlighting useful information, suggesting conclusions, supporting decision making (Orodho, 2012; Orodho, Ampofo, Bizimana & Ndayambaje, 2016).

**Objective 1:** Data were analyzed using both qualitative and quantitative analysis method. Gathered information were analyzed through calculations of percentages and statistical presentation of the information was made through pie-charts, frequency tables and graphs. Qualitatively, those issues describing the outcome of the research were also analyzed.

**Objective 2:** Gathered information was analyzed through calculations of percentages and statistical presentation of the information made through pie-charts, frequency tables and graphs.

**Objective 3:** Data were analyzed quantitatively and to a lesser extent qualitatively. Information gathered was analyzed through calculations of percentages and statistical presentation of the information made through pie-charts, frequency tables and graphs.

**Objective 4:** In this objective of developing strategies, collected data was compiled and discussed in theme. Observation schedule was analyzed qualitatively.

3.10   Logistical and Ethical Considerations

(a) Logistical Consideration

In research, careful planning is crucial considering that research is a very expensive undertaking in terms of time, financial and human resources. The factor of time was very crucial since the county involved is vast. Therefore, prior arrangements for faster and efficient means of accessing the schools was made. The research could
have involved a lot of funds in terms of developing and producing research instruments, therefore tightening the budget was crucial. The scope of the study could not allow collection of data in total because of the massive target population involved. In view of this, the researcher enlisted all the respondents in the target population from which random sample technique was used to get the sample size. Randomness of the sample affects the degree to which results from the sample can be generalized.

(b) Ethical Principles

Educational research invades a person’s privacy. Therefore, respondents’ participation in this research was voluntary. Direct consent for participation was obtained from the respondents. The informed consent involved the consent of the subjects as to what would be disclosed to the researcher, and also the assurance of the confidential use of the research data collected on individuals that the information gathered was to be kept confidential and would only be used for the stated purpose of the research. Responses from the participants, strict anonymity was observed. Human rights and public relations was strictly adhered to. The researcher avoided plagiarism which amounts to copying another researcher’s work without acknowledging the source.
CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND DISCUSSIONS

4.1 Introduction

This chapter presents the findings of the study. General information on the study is provided on the effect of laboratory management on students’ performance in physics in public secondary schools in Bomet County, Kenya. The study used primary data gathered through questionnaires, interview and observation schedules. The chapter presents demographic information of the respondents as well as the analysis for each of the four research objectives stated below:

The study sought to:

1. Establish the mechanisms that the principals in Bomet County have put in place to ensure adequacy, effective and efficient utilization of physics laboratory resources and the effects on students’ performance in physics.

2. Determine the efficiency and effectiveness of the schools’ laboratory safety measures in creating a secure learning environment to enhance students’ performance in physics in Bomet County,

3. Evaluate the challenges facing the secondary schools in management of physics laboratories and their relation to students’ performance in physics in Bomet County.

4. Develop strategies of improving laboratories management that boost students’ academic performance of physics in Bomet County.
4.2 Demographic Data Analysis

Demographic data that the study sought from the respondents included gender, academic qualifications, experience and duration in the current station. The findings are as in the following figures and tables.

(a) Respondents Gender

Respondents’ data on their gender is presented in figure 4.1:

Figure 4.1: Respondents Gender

Data collected from the respondents indicate that 7(88%) and 12(75%) of the Heads of Department and Physics teachers respectively where male while for Laboratory technicians and students’ respondents 38% were females. This analysis shows how skewed physics management and teaching is in favour of male dominance in Bomet County. This situation whereby majority of the top management and staff in Physics are males may have played a key role, to extent, in students choosing of Physics because they will think that it is meant for men and is therefore a tough subject. This might have led to their developing phobia towards the subject.
(b) Respondents Level of Qualification

Figure 4.2.2 below the level of academic qualification of the HODs, physics teachers and lab technicians.

**Figure 4.2: Respondents Level of Qualification**

Majority of the Physics teachers and Heads of Department respondents 14(88%) and 6(75%) respectively had degree as their level of qualification. This means that they all have education and training above the secondary school level which, therefore, implies that they have the required education to handle secondary school’s laboratories efficiently.

(c) Respondents experience

The respondents’ experiences in their roles as HODs and as physics’ teachers are as shown in table 4.1 that follows:
Table 4.1: Respondents Length of Service

<table>
<thead>
<tr>
<th>Serial No.</th>
<th>Years</th>
<th>Heads of Department</th>
<th>Physics Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>1 – 5 years</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>6 – 10 years</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>3.</td>
<td>11 – 15 years</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>4.</td>
<td>16 – 20 years</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>5.</td>
<td>Over 20 years</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>8</strong></td>
<td><strong>100</strong></td>
<td><strong>16</strong></td>
</tr>
</tbody>
</table>

Majority of the Heads of Department and Physics teachers (5 and 10 accounting for 63% of each) had mainly worked for a period of 6 to 10 years. No respondent had worked for one to five years or for over twenty years. HODs who have stayed long enough in their schools are able to provide the needed data on challenges faced in laboratory management, factors that contribute to poor performance in physics and provide suggestions for improving this performance.

(c) Duration in the Current Station

Information was sought on the number of years that the respondents had stayed in their current stations. The information obtained is as indicated in figure 4.2(c) and table 4.2 that follow:
Among the 8 respondents who were mainly Heads of Department, 6(75%) had stayed and worked in their current station for a duration of between 6 – 10 years followed by another 2(25%) who had stayed for 11 -15 years. None had stayed for less than 5 years or for 16 years.

**Table 4.2: Students Respondents Class**

<table>
<thead>
<tr>
<th>Class</th>
<th>f</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form 1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Form 2</td>
<td>46</td>
<td>28.75</td>
</tr>
<tr>
<td>Form 3</td>
<td>40</td>
<td>25</td>
</tr>
<tr>
<td>Form 4</td>
<td>74</td>
<td>46.25</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>160</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Majority of the students’ respondents 74(47%) were mainly form 4 students. None came from the form 1 class. Students from senior classes are assumed to have gone through a lot of interaction with the learning processes to be able to give reliable responses on the items on the questionnaires.
4.3 Resources and Students’ Achievements in Physics

The first objective sought to establish the adequacy of the laboratory resources in schools in Bomet County. It also sought to evaluate the mechanisms used to ensure that the available resources are efficiently and effectively used in achieving the specific learning objectives in physics’ class lesson.

4.3.1 Adequacy of Teaching and Learning Resources

Figure 4.5 below represents the responses of physics teachers and laboratory technicians on the adequacy of the physics’ laboratory resources in secondary schools in Bomet County.

**Figure 4.4: Adequacy of Teaching and Learning Resources**

On the issue of adequacy of teaching and learning resources, majority of the Physics teachers (63%) and half of the laboratory technicians involved in the study indicated that they were adequate. However, 50% of the physics teachers and 38% of the lab technicians said these resources were not adequate. This variation in opinions between physics teachers and the lab technicians shows the likelihood that the laboratory technicians failed to fully note on the availability of the physics
laboratory resources which could mean that either the resources available are not fully utilized so that there is no need even for their sufficiency or they are not involved at all in the procurement process so that they are not aware of what could be lacking in the Physics laboratory.

The types of physics laboratory teaching resources mostly used were measuring instruments like metre rules, micrometer-screw gauges, optical instruments like mirrors and lenses and other apparatus such as the burners, Eureka cans and calorimeters. Chemicals included acids, bases, salts, metals, non-metals. Other equipment were cells, connecting wires, cell holders, bulbs, weighing balances, retort stands, galvanometers, turn table and periodic tables. This indicates that the adequacy and variety of the teaching and learning physics laboratory resources has not been achieved in almost all schools in Bomet County. Lack of sufficient resources is a great setback to the learning process. Akinsanya (2010) commenting on educational resources says that they are important because the goal of any school depends on adequate supply and utilization of physical and material resources among others as they enhance proper teaching and learning.

4.3.2 Procedure used by HOD in acquiring physics laboratory resources

Physics resources are usually ordered by the school from a supplier who has qualified through the tendering process. Procurement processes are made then forwarded to the school management for action. The lab assistant is in charge of receiving and recording the materials brought for physics in school, annual stock taking of the resources in the physics laboratory and filling forms on time. All the findings from the HODs were in agreement in this procurement process.
4.3.3 Frequency of Inspecting Laboratory Activities

On the issue of overseeing that the physics’ laboratory lessons are effectively undertaken the HODs and physics’ teachers were asked to state the frequency with which this inspection is done and whether feedback of the inspection is given thereafter. Their responses are captured in table 4.3 and figure 4.8 that follow:

Table 4.3: Frequency of Inspecting Laboratory Activities

<table>
<thead>
<tr>
<th>Serial No.</th>
<th>Duration</th>
<th>Heads of Department</th>
<th>Physics Teacher</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Once a month</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2.</td>
<td>Twice a month</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>3.</td>
<td>Once a term</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>4.</td>
<td>Twice a term</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>5.</td>
<td>Never</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>6.</td>
<td>Any other time</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>16</td>
<td>16</td>
</tr>
</tbody>
</table>

Inspection of laboratory activities by the Principals was done at least twice per term according to 75% of the Physics teacher respondents. However, a total of 50% of the Heads of Departments said it was conducted at least twice in a term. Principals of the sampled schools gave various comments on inspection of laboratory activities. Some pointed out that they visited the laboratory only when other office duties were not pressing. Others ensured that they visited at least once in a week.
All the respondents 16(100%) agreed that principals do not inform them before getting into class for inspection. Among them, only half 4(50%) indicated that they get written feedback after the inspection while the other half did not. This indicates that some schools do not take seriously the intent of class inspection as a correctional exercise to guide the learning process. Feedback is important for inspection to serve its purpose. Mobegi, Omolo and Simatwa (2010) views this inspection role of the head teacher as crucial in ensuring that school learning resources are maximally used.

4.3.4 Teachers’ Preparedness for Physics’ Laboratory Lessons

The study sought evidence on how well physics’ teachers are prepared for physics’ laboratory class lesson. The physics’ teachers’ respondents were therefore required to state the professional documents that they usually prepare. Their responses were as seen in table 4.7 that follows:
Both the HODs and the Physics teacher indicated totally that professional document such as schemes of work and record of work were available. HODs also indicated that the students’ progress records were available. Professional documents that were not available to all included lesson plans with both HODs and Physics teachers’ responses indicating 4(50%) and 10(63%) respectively. As per the lesson notes, only 4(25%) Physics teacher’s respondents had them.

4.3.5 Are Practical Skills Tested in Bomet Schools’ internal exams?

The physics’ teachers were required in their questionnaires to state whether they give their students standardized tests that include practical. The responses are captured in table 4.5 below:

<table>
<thead>
<tr>
<th>Comment</th>
<th>f</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>12</td>
<td>75</td>
</tr>
<tr>
<td>No</td>
<td>4</td>
<td>25</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>16</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Table 4.4: Is Standardized Science Examination offered?
Majority of the Physics teachers’ respondents 12(75%) said that they offered standardized science examinations while 4(25%) did not. A standard exam will evaluate all areas in the cognitive domain and is therefore crucial tool to assess the learning progress and for making informed decisions that affect learning.

4.3.6 Coverage of Physics’ Experiments Suggested in the KCSE Course Books

The physics’ teachers participating in the study were asked whether they administer all the experiments suggested in physics KCSE course books. The findings are given in figure 4.9 below:

Figure 4.7: Cover the Required KCSE Physics Examination Syllabus Experiments

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>20</th>
<th>40</th>
<th>60</th>
<th>80</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/A</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Don't know</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>12.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>87.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

On whether these teachers covered the required KCSE examination syllabus experiments before the commencement of the KCSE examination, majority of the respondents 14(88%) indicated that they did while 4(13%) said they did not.
Table 4.5: Extent of KCSE Syllabus Experiment Coverage

<table>
<thead>
<tr>
<th>Serial No.</th>
<th>Comment</th>
<th>f</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Very great extent</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>Great extent</td>
<td>3</td>
<td>37.50</td>
</tr>
<tr>
<td>3.</td>
<td>Undecided</td>
<td>13</td>
<td>62.50</td>
</tr>
<tr>
<td>4.</td>
<td>Little extent</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5.</td>
<td>Very little extent</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>16</td>
<td>100</td>
</tr>
</tbody>
</table>

Majority of the respondents 13(63%) were undecided on response to the extent of KCSE syllabus experiment coverage. Only 3(38%) agreed they covered this syllabus to a great extent. Those who said they were undecided pointed out some issues which posed as challenges to syllabus coverage. Some issues identified were due to insufficient period as many a time there are many events allocated each term e.g. examination period, parents meeting, half term and many other term dates hence affecting the flow of teaching.

There are others whose opinions were different. The indicated that they were able to cover experiments in the course book as the designated syllabus was covered in time to pave way for extra revision work which included practical being done often as per scheduled dates.

4.3.7 In-servicing of Laboratory Personnel

The laboratory technicians participating in the study were asked whether they go for in-servicing courses and how often they do so. Figure 4.10 and 4.11 give a summary of their responses.
Data collected indicated that 5(62%) respondents attended in-service courses while 3(38%) did not. This shows that some schools do not see the importance of in-servicing of the laboratory personnel. In-servicing according to Rebore (2004) is necessary for the school to maintain a skilled and knowledgeable staff.

Among the five respondents who attended in-service courses, 4(80%) attended these in-service courses yearly while 1(20%) attended termly. None of the respondents attended monthly. They also pointed out that other than attending these courses they
also acquire skills and experience from the Physics teachers and from fellow laboratory technician from the neighbouring schools.

4.4 Safety Measures and Students’ Achievements

The second objective was to evaluate the schools’ laboratories safety measures for provision of a secure learning environment.

In response to the question of measures that have been put in place to prevent and control accidents the principals, HODs, and lab assistants cited that laboratory technician have been made responsible in arrangement or setting up the apparatus so as to ensure that the experiment proceeds safely. This is because they are more conversant with the safety procedures in a given experimental process. Also mentioned was that experiments are done in groups of two. Small groups, apart from allowing more hands-on tasks, gives the teacher the chance to motivate and build students’ confidence. Lack of confidence while handling apparatus can result in accidents. Learners are also familiarized with laboratory safety rules and are expected to follow them. This means that they are made aware of the expected mannerism in the laboratory so that they can avoid accidents and injuries during a class experiment. Ensuring proper handling and storage of apparatus and chemicals during and after a class experiment session was also mentioned. Careless handling of chemicals and apparatus are potential causes of accidents in school laboratories. The proper storage of apparatus ensures easy retrieval apart from longevity of use, creating awareness to students of the possible dangers and risks in an experimental setup and processes. Availability water supply is what most schools use in case of fire outbreaks that are not caused by either oils or electric faults. A bucket full of
sand with a shovel protection have been put in standby in some of the schools that took part in the study in case of fires due to electric faults. Protection gloves in handling corrosive substances are available in almost all schools visited for the study. Use of closed shoes was also mentioned. Fire extinguishers have been fitted at strategic points and was what most respondents considered important safety equipment. Other measures mentioned included turning off the electric switches when not in use, ensuring learners conduct the experiments in the presence of the teacher who should take charge of giving safety guidelines to be followed during the experiment, class management so as to control the rogue learners who might not be ready to follow the safety rules diligently exit doors in the participating schools are properly placed ,are wide enough and opens outside for easy escape in case of an accident such as fire outbreaks. The schools sampled had well ventilated rooms which ensures that the effect of dangerous fumes that could be produced in the course of an experiment or from leaking chemical containers are substantially minimized. All the laboratories of the schools participating in the study had non slippery floors. Non slippery floors minimizes the incidences of falling that could result in injuries and spillages of fuming poisonous or flammable substances that could easily result in devastating fires. Non-grilled windows were evident in the schools sampled. This is also for easy escape in case of fires outbreaks. First Aid Box which is meant to provide minor or preliminary treatment in case of an injury was also cited by majority of the respondents. It therefore requires that the subject teacher and/or the laboratory technician is within the laboratory as the students perform the experiment so that incase of any accident the necessary action is taken as fast as possible before it reaches a devastating extent. In case of a great fire outbreak the school should call firefighting brigade to assist. It is also necessary to
train the school personnel on fire management skills for them to have broad knowledge to be able to identify the kind of the fire, knowing the right class of each so as to be able to combat very well and successfully. They should be able to use fire extinguishers well. Electric circuit installed in every part of the school should be fused such that in case of an electric fault the circuit will automatically break thus avoiding electric fire accident cases. Putting in place First Aid Kit and having well trained personnel as first aiders who attend to cases immediately should be every school’s priority because it helps to attend to injuries sustained during any form of accident.

4.4.1 Level of Preparedness of the School

The HODs and Physics teachers were asked in their respective questionnaires to give their opinion on whether their schools were well prepared to deal with all forms of accidents in case it occurs in the school. Majority opined that with the case of fire, the school is well equipped with fire extinguishers and emergency exits doors are available. Some of the schools have also put in place a well-known fire assembly zones. Availability of piped water in majority of the schools enables them to experience constant supply of water that is very crucial in containing fires other than those caused by electric faults and petroleum products. Enough sand in buckets in schools were reported by the respondents. This are useful also in firefighting.

For schools with no sophisticated firefighting equipment therefore will use the little skills by whistling to alert the neighbours and also use the available water and sand.
4.5 Challenges Facing the Secondary Schools in Management of Physics Laboratories in Bomet County

On the third objective that sought to establish the challenges facing management of schools’ physics’ laboratories and their effect on learners’ performance of physics, the respondents who included HODs and Physics’ teachers were required to rate their schools’ KCSE Physics performance before proceeding to enumerate on what they believe contributes to the good or the poor performance of physics by their students in KCSE examination. Figure 4.12 and table 4.7 that follow provide the findings.

**Figure 4.10: Rating KCSE Physics Performance**

From the teachers’ responses, 10(63%) indicated that the performance was good followed 4(25%) saying the performance was poor.

4.5.1 Reasons Contributing to Poor Performance

On challenges facing laboratory management the HODs were asked to state reasons that they believe are contributing to the poor performance of Physics in KCSE. The majority of them cited the poor attitude by most learners towards the physics subject
especially the girls. This shows that the negative attitude that the SMASSE project purposed to change is still persistent which could mean that either the implementation of the programme has not been sufficiently done or other factors that are contributing to this negative attitude have not been addressed. The right physics learning environment must be created in each and every school for learners to find physics joyful and motivating to learn. This can be achieved by ensuring that students get the hands-on, minds-on, hearts-on experience in the learning of physics which will make the subject look practical and applicable to the learner. Learning of science is enhanced through practical experiments. Hudson (2009) compared achievements of students taught by laboratory with those taught by lecture. He found out that students taught by laboratory methods achieved more acquiring scientific knowledge. This means that the right variety of physics resources must be made available and sufficiently as noted by Mapederun (2012) who had emphasized that the availability and adequacy of educational resources affect the academic performance positively.

The manpower to utilize the teaching resources need to be given the appropriate training and be well motivated to work to their capacities. Proper laboratory organization must be done so as to ensure easy access and retrieval of available resources. Moreover, a safe learning environment has to be ensured. Also more topics being covered at ago by the teacher was mentioned. This, they said, leads to confusion because the proper sequencing of content will not be easy to achieve when so many concepts are presented without breaks. Many schools give pressure to teachers on when the syllabus for all subjects offered in the school should be covered without taking into consideration the different nature of these subjects.
Physics being a science subject is mostly learnt through the processes of observation, measuring, experimenting, interpreting data and making conclusions. The processes therefore, requires appropriate time which might not be the case with the rest of the subjects. Crushing of the content within the shortest time without considering the ability of the learners will lead both to learning impairments and development of negative attitude towards the subject. The learner will not be able to master the same content well. The teachers’ mastery of the content was also mentioned. This could be due to the heavy workload of the teachers which leaves them with less time for lesson preparation which implies that proper syllabus coverage will consequently not be adhered to as expected. Other reasons mentioned were that of relying on class texts, that is, lack of revision books to expose students to many revision questions, irregular evaluation of students, frequent change and transfer of teachers which create gaps in syllabus coverage and laziness among learners and teachers which could be as a sign of demotivation brought about by either school internal or external factors such as low pay, failure to recognize the workers efforts through such things as promotion, and so forth.

Observations made in the schools involved in this study indicated that in some schools’ apparatus in the laboratory were well arranged. They were well labeled and put in partitions. Chemicals were arranged alphabetically. In these schools, learners level of interest during Physics laboratory class lesson was satisfactory. Safety devices were adequate and requisition documents were available indicating recent purchases. The situation was different in other schools. Laboratory apparatus were heaped together showing poor and inadequate storage space. Safety devices were
inadequate and students showed low levels of motivation. The available requisition documents had dates of the previous year.

Table 4.6: Challenges Encountered in a Laboratory Class

<table>
<thead>
<tr>
<th>Challenges</th>
<th>f</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insufficient Laboratory Equipment</td>
<td>14</td>
<td>58.30</td>
</tr>
<tr>
<td>Lack of exposure to practical examination</td>
<td>13</td>
<td>54.16</td>
</tr>
<tr>
<td>Faulty apparatus</td>
<td>8</td>
<td>33.33</td>
</tr>
<tr>
<td>Blocked sinks</td>
<td>12</td>
<td>50</td>
</tr>
<tr>
<td>Faulty Gas System</td>
<td>2</td>
<td>8.33</td>
</tr>
</tbody>
</table>

Students respondents cited various challenges in relation to laboratory classes they face in school. Insufficient laboratory equipment, lack of exposure to practical examination and blocked sinks topped their list with 14(58%), 13(54%) and 12(50%) respectively. Other challenges cited were insufficient stop watches, lack of laboratory in some institutions, few Physics teachers, and laboratories being in poor state.

4.5.2 Reasons Contributing to Good Performance in Physics

Part two of the question on the challenges facing physics laboratory management required the HODs the state what they believe can contribute to good performance of physics. The same question was asked the physics teachers. They stated the provision of adequate learning and teaching resources, proper coverage of the syllabus and on time to allow learners revise adequately, inculcating proper attitudes in the learners and encouraging and motivating them to work harder, giving remedial classes to challenged students, schools getting enough and qualified Physics teachers
and committing the learners to more frequent practical as what could see physics rise in both performance and enrollment.

4.6 Strategies for Improving Management of Physics’ Laboratories so as to Boost Students’ Performance in Physics in Bomet County

The fourth objective was on strategies that can be put in place to improve on students’ performance in physics. On this objective the HODs participating in the study were asked to give their opinion on the genuine measures that they think could be used to improve KCSE physics performance in Bomet County. Their statements were that school principals were to avail adequate equipment and apparatus on time to ensure that they are utilized for learning and the right time. School principals also, according to their opinion, are expected to motivate teachers and students so as to perform to their level best, employing more teachers of Physics to reduce workload, topical exams to be administered regularly to ensure deep and exhaustive revision of every physics topic that has been covered and to acquaint them with questioning techniques used by examiners. Also suggested was that practical to be done by individual student regularly which makes sure that all the learners are made to interact with the laboratory teaching and learning resources at individual level, early syllabus coverage should be aimed at right from the time of entry of the learner to the secondary level of education so that the pressure of syllabus coverage is not concentrated towards the end of the secondary course when the exams are near, remedial classes given to challenged learners to try to bring them to be at par with the fast learners. To the government it was suggested that they should give enough funds to the science department so that the laboratory resources are availed to science teachers and also that more science teachers should be employed so that the
workload of teachers are reduced and quality performance achieved. Reduced workload ensures contact with the learners is enhanced which makes individualized coaching possible. The teacher-learner interaction should be increased hence creating more time for laboratory activities.

In order to motivate learners, suggestions of schools inviting professionals for a talk, exposure through trips to relevant learning sites where certain concepts learnt in a lesson are applied, changing of learners’ attitude through mentorship were made. For enhancing the potentiality of service delivery refresher courses for teachers and technicians were cited. Taking affirmative action towards the subjects Science club e.g. Science Congresses is to be encouraged in order to improve on creativity on the side of the learners, frequent testing of learners through exams should be done to identity their weaknesses, teachers of Physics be encouraged to use teaching and learning resources maximally so that the learners can reap the full benefits of the resources in building their cognitive and psychomotor skills, Involving the examiners to encourage and teach learners on techniques of answering Physics questions in exams, thorough revision on the content after the syllabus through class discussions and frequent testing were also seen by many of the HODs as appropriate measures of improving performance in physics.
CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the summary of the findings, conclusions and recommendations. It also gives suggestions for further studies.

5.2 Summary of the Findings

The summary of the findings stated below has been organized by the objectives that guided the study.

(a) Demographic data

Demographic data collected from the respondents included gender of the respondents, their level of academic qualifications, their relevant experience in area of jurisdiction and their years of stay in the current stations. The data collected shows that majority of the physics teachers and laboratory technicians respondents were between the age of 26 – 35 years. Age of participants indicates maturity level that could be vital in management, service delivery and guidance of learners. Another respondents’ data indicates that majority of the Heads of Department and Physics teachers where males and another response showed that the HODs and physics teachers have mainly worked for a period of 6-10 years and most of them have degree as their level of qualification.

(b) Acquisition and Utilization of Physics’ Laboratory Resources

The first objective that was on the acquisition and utilization of physics’ laboratory resources has been examined in terms of their adequacy, learners attitudes towards laboratory class lessons, procurement procedures for acquiring the resources, lesson
supervision, testing of practical skills in schools’ internal tests, extent of coverage of recommended experiments in secondary school coursework and the frequencies with which in-servicing programs are undertaken at the various schools sampled for research.

(i) Adequacy of Physics’ Laboratory Resources
On the issue of adequacy of teaching and learning resources, majority of the respondents involved namely physic teachers and laboratory technicians indicated that the resources were adequate.

(ii) Learners Attitude Towards Laboratory Class Lessons
Physics teachers were asked if they were satisfied with the learners’ attitude towards their class laboratory activities. Majority of them indicated that they were satisfied.

(iii) Procurement Procedures for Acquisition of Physics’ Laboratory Resources
Physics resources are usually ordered by the school through the supplier who has qualified through the tendering process. Procurement processes are made then forwarded to the school management for action.

(iv) Supervision of Laboratory Class Lessons
Inspection of laboratory activities by the Principals was mainly done once per term. Professional document such as schemes of work and record of work were available even though the lesson plans were not available to all.
(v) **Testing of Practical Skills in Physics**

Majority of the Physics teachers’ respondents said that they offered standardized science examinations while others did not. This means that the majority of the teachers test the practical skills in their learners.

(vi) **Coverage of the Recommended Physics’ Experiments**

The required KCSE examination syllabus experiments was mainly covered before the commencement of the KCSE examination. This was commented by a fair number of the physics’ teachers’ respondents though the majority of the respondents were undecided on response to the extent of KCSE syllabus experiment coverage.

(vii) **In-servicing of Laboratory Personnel**

Among the respondents who attended in-service courses, a high number attended these in-service courses yearly. The respondents also pointed out that other than attending these courses they also acquire skills and experience from the Physics teachers and from fellow laboratory technician from the neighbouring schools.

(c) **Preventing and Controlling Accidents in School Laboratories**

Measures of preventing accidents included familiarizing the learners with laboratory safety rules to ensure proper handling and storage of apparatus. Fire extinguishers be fitted at strategic points. It’s important for learners to conduct the experiments in the presence of the teacher and or the laboratory technician for monitoring purposes.

Some ways of dealing with possible major accidents will include having broad knowledge to be able to identify the kind of the fire, knowing the right class of each so as to be able to compact very well and successfully. Fire extinguishers should be
used in case of fire accidents. The First Aid Kit should be available in case of any unforeseen emergencies. As well as trained personnel as first aiders who attend to cases immediately. In case of fire, most schools were well equipped with fire extinguishers and emergency exits doors. These schools have also put in place a well-known fire assembly zone. Unfortunately, some lacked the sophisticated firefighting equipment therefore will use the little skills by whistling to alert the neighbours and also use the available water and sand.

(d) Challenges Facing Physics’ Laboratory Management. The HODs and physics’ teachers’ respondents were required to rate their schools’ performance in physics in previous KCSE examinations and suggest reasons contributing to either good or poor performance of physics in the schools. On reasons contributing to poor performance, some respondents cited poor attitude by most learners towards the physics subject especially the girls. Many schools also lacked enough Physics laboratory learning resources. Reasons advanced for contributing to good performance in Physics included provision of adequate learning and teaching resources, proper coverage of the syllabus and on time to allow learners revise adequately and inculcating proper attitudes amongst the learners and encouraging and motivating them to work harder. Measures of improving Physics performance were not limited to school principals availing the equipment on time, administering topical exam regularly and covering the syllabus early to ensure thorough revision on the content after the syllabus coverage.
5.3 Conclusions

Based on the findings of the study, it can be concluded that almost all the schools that took part in the study did have a number of physics laboratory management issues that might have been the major hindrances to the teaching and learning of physics in public secondary schools which has thus resulted in the low enrollment of learners in physics and the dismal performance of the students in physics KCSE examination results. The management issues include: lack of a clear programme of in-servicing of laboratory personnel, lack of proper coordination between the physics department and the examination departments in most schools which has resulted in failure to accommodate practical in schools’ internal evaluation exams, lack of proper supervision which makes early detection of teaching and learning difficulties to escape unnoticed in good time so as to provide timely solution, failure to embrace participatory decision making in the procurement of physics laboratory teaching/learning resources, among others. All these contributes to continued failure to meet the instructional objective in the learning of physics that eventually builds into dissatisfaction and negative attitude towards physics by the learners.

5.4 Recommendations

From the findings of the study, the following are the recommendations:

5.4.1 Policy Recommendations

1. The examination departments in secondary schools should ensure that practical skills are tested in the schools’ internal examinations so as to reflect the summative KCSE examination standards
2. The County Education Office of Bomet should come up with a policy of equitable distribution of resources such that the schools that are less established should be getting a better share of the resources.

3. The County Education Office of Bomet should take over the responsibility of ensuring safety in the schools. Safety of a school is so important and therefore should not be left at the mercy of the school management such that the purchase of safety equipment becomes a right of every school rather than an option by the school board of management.

4. The ministry of education should make an effort of reversing the current state of learners’ enrollment in physics subject as a matter of urgency. They can use the mass media to try and change the parents’, public and learners’ perception of physics. The importance of physics should be stressed so as to win back the hearts of the learners who at present seems to be running away from it.

5. Laboratory technicians should be employed directly by the government, just like the teachers employed by teachers’ service commission(TSC), so that their duties are fully recognized and to make sure that no learners in any school suffer in their education pursuit because of their unavailable services in schools that do not see the need of employing these important workers.

6. The quality assurance wing of the teachers’ management should take upon themselves the role of in-servicing of the laboratory personnel to ensure they remain relevant throughout their stay in schools.

5.4.2 Suggestions for Further Research

1. A similar study should be carried out in private secondary schools in Bomet County, Kenya.

2. Studies to be done on quality of programmes offered to principals on effective management practices on laboratories in Kenya.
REFERENCES


APPENDICES

Appendix I: HOD’s Questionnaire

This questionnaire is for the purpose of gathering information on impact of laboratory management on performance of physics in public secondary schools in Bomet County. You are kindly requested to fill in the questionnaire and your honest responses will be highly esteemed.

SECTION A: Background Information

1. Age
   21-25 years [ ]  26-30 years [ ]  31-35 years [ ]
   36-40 years [ ]  41-50 years [ ]  above 50 years [ ]

2. Please indicate your gender by use of a tick (√)
   Male [ ]  Female [ ]

3. Experience as an HOD science (Indicate with a tick (√))
   0-5 years [ ]  6-10 years [ ]  11-15 years [ ]
   16-20 years [ ]  21-25 years [ ]  above 25 years [ ]

4. How many years have you been in your current school?
   0-5 years [ ]  6-10 years [ ]  11-15 years [ ]
   16-20 years [ ]  21-25 years [ ]  above 25 years [ ]

5. Please indicate your highest academic qualification (Indicate with a tick (√))
   Elementary (EACE/KCSE): (Certificate level and below) [ ]
   Intermediate (Dip Ed): (College diploma level) [ ]
   Bachelors’ degree (BEd): (University degree) [ ]
   Masters degree (MEd): (Masters degree) [ ]

80
SECTION B: Acquisition and Utilization of Laboratory Resources

6. What procedures do you use in acquiring physics laboratory resources to ensure cyclic flow?

7. Please indicate whether physics teachers in your school prepare the following professional documents. Tick (✓) as many as appropriate.

<table>
<thead>
<tr>
<th>Scheme of Work</th>
<th>Lessons plan</th>
<th>Records of Work</th>
<th>Student progress record</th>
<th>Lesson notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

7. How often do you inspect laboratory activities during physics lessons to ensure quality learning take place?

<table>
<thead>
<tr>
<th>Once a month</th>
<th>Twice a month</th>
<th>Once a term</th>
<th>Twice a term</th>
<th>Any other (specify)</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td></td>
</tr>
</tbody>
</table>

8. How many laboratory personnel do you have in your school and what are their level of qualification?

9. In your opinion do you offer standardized examinations to your students that include practicals in physics?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

SECTION C: Measures for Preventing and Controling Accidents

10. In what ways do you ensure safety in the physics laboratory?

<table>
<thead>
<tr>
<th>i.</th>
<th>ii.</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

SECTION D: Challenges Facing Laboratory Management.

11. How do you generally rate the K.C.S.E physics performance in your school for the last 5 years (2010-2015)

<table>
<thead>
<tr>
<th>Excellent</th>
<th>Good</th>
<th>Average</th>
<th>Poor</th>
<th>Very poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>
12. In your opinion,
a) What do you think are the reasons contributing to poor performance of physics in KCSE? (Please list the reasons below)
i) ........................................................
ii) ................................................................
iii) ................................................................
iv) ................................................................

b) What do you think are the reasons contributing to good performance of physics? (please list the reasons below)
i. .............................................................
ii. ................................................................
iii. ................................................................
iv. ................................................................

SECTION E: Possible Solutions to the Challenges
13. In your opinion, what other measures can be used to improve KCSE physics performance in BOMET County?
i. ................................................................
ii. ................................................................
iii. ................................................................
iv. ................................................................

Thank you
APPENDIX II: PHYSICS TEACHERS’ QUESTIONNAIRE

This questionnaire is divided into two Section A and B. Please complete each section honestly according to the instructions given. Do not write your name and the name of your school to ensure complete confidentiality. Please respond to all questions.

SECTION A: Background Information

1. Gender:
   Male [ ] Female [ ]

2. Age bracket
   Below 25 years [ ] 25 Years to 35 years [ ]
   36 to 45 years [ ] 46 years and above [ ]

3. Highest academic qualification
   Master degree [ ] B.Ed [ ] Certificate and below [ ]
   Diploma [ ] Any other (specify) .................................................................

4. For how long have you been in the teaching profession?
   1-5 years [ ] 6-10 years [ ] 11-15 years [ ]
   16-20 years [ ] Over 20 years [ ]

SECTION B: Acquisition and Utilisation of Laboratory Resources

5. Does your school have adequate teaching and learning laboratory physics resources?
   Adequate [ ] Not adequate [ ]
   Not at all [ ]

If adequate or inadequate, list the type of physics laboratory teaching resources you mostly use in your class/school.
**Instruction:** Please respond to each of the following questions by putting a tick ( ) next to the appropriate response.

6. Are you satisfied with your learners attitude towards your class laboratory activities in your subject?
   - Yes [  ]
   - No [  ]

   If No, what brings about their attitude? .................................................................
   ........................................................................................................................................

7. Please indicate whether you prepare the following professional document. Tick as many as appropriate
   - Schemes of work [  ]
   - Lessons plan [  ]
   - Record of work [  ]
   - Student progress [  ]
   - Lesson notes [  ]

8. (i) How many times are you inspected by your head teacher during a laboratory class?
   - Once a month [  ]
   - Twice in a month [  ]
   - Once a term [  ]
   - Twice a year [  ]
   - Never [  ]
   - (If any other specify) .................................................................

   ii) Do the principal inform you about the inspection before coming to your class?
   - Yes [  ]
   - No [  ]

9. Do you get written feedback after observation?
   - Yes [  ]
   - No [  ]

10. Do you offer standardized physics examinations that include practicals to your students?
    - Yes [  ]
    - No [  ]

    If Yes, what is their impact on performance in KCSE examinations? ......................
    ........................................................................................................................................
11. i) Do you cover the required KCSE physics examination syllabus experiments before the commencement of the KCSE examination?
   Yes [   ] No [   ] Don’t know [   ] N/A [   ]

   ii) If No, to what extent do you cover the KCSE syllabus experiments?

   ..............................................................................................................................
   Very great extent [   ] Great extent [   ] Undecided [   ]
   Little extent [   ] Very little extent [   ]

   iii) Please explain your response in (ii) above.

   ..............................................................................................................................

SECTION C: Measures for Preventing and Controlling Accidents.

8. What measures are in place for:
   a) Preventing accidents?

   ..............................................................................................................................
   b) Dealing with possible occurrence of a major accident?

   ..............................................................................................................................
   c) In your own opinion, is the school well prepared to deal with an accident (like fire outbreak, etc) incase it occurs in the laboratory premises? explain briefly

   ..............................................................................................................................

SECTION D: Challenges Facing Laboratory Management.

9. i) How do you rate the KCSE physics exam performance of your school?

   Excellent [   ] Good [   ] Undecided [   ]
   Poor [   ] Very poor [   ]

   ii) If the answer to 9 (i) is (d) or (e) list the possible causes.

10. i) In your own opinion how does coverage of the experiments syllabus affect performance of physics in national examinations? Explain your answer

   ..............................................................................................................................
   ii) In your opinion, suggest other factors that influence performance of physics in KCSE in your school

   ..............................................................................................................................

SECTION E: Possible Solutions to the Challenges.

11. What in your opinion can be done to improve the performance of physics?

   ..............................................................................................................................

Thank you
Appendix III: Laboratory Technician’s Questionnaire

This questionnaire is divided into two Section A and B. Please complete each section honestly according to the instructions given. Do not write your name and the name of your school to ensure complete confidentiality. Please respond to all questions.

SECTION A: Background Information
1. Gender
   Male [ ] Female [ ]

2. Age bracket
   Below 25 years [ ] 25 Years to 35 years [ ]
   36 to 45 years [ ] 46 years and above [ ]

3. Highest academic qualification
   Certificate [ ] Diploma [ ]
   Any other (specify) .................................................................

SECTION B: Acquisition and Utilisation of Laboratory Resources
4. Does your school have adequate teaching and learning laboratory resources?
   Adequate [ ] Not adequate [ ] Not at all [ ]
   If adequate or inadequate, list the type of Physics laboratory teaching resources you mostly use in your school.

5. Do you go for in-service courses?
   Yes [ ] No [ ]
   If yes, how often?
   Monthly [ ] Termly [ ]
   Yearly [ ] Others, specify ............................................................

SECTION C: Measures for Preventing and Controlling Accidents.
6. What measures are in place for:
   a) Preventing accidents? ............................................................
   b) Dealing with possible occurrence of a major accident? ............
c) In your own opinion, is the school well prepared to deal with an accident (like fire outbreak, etc) incase it occurs in the laboratory premises? explain briefly........................................................................................................

SECTION D: Challenges Facing Laboratory Management.

7. How would you rate the effectiveness of your principal in physics laboratory management?

<table>
<thead>
<tr>
<th>Very effective</th>
<th>Effective</th>
<th>Satisfactory</th>
<th>Ineffective</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

Explain your answer........................................................................................................

8. What challenges do you experience in executing your mandate as a lab technician?.................................................................................................................................

SECTION E: Possible Solutions to the Challenges.

9. In your opinion what can be done to mitigate the challenges in physics laboratory?

........................................................................................................................................

Thank you
Appendix IV: Student’s Questionnaire

This is a questionnaire to find out how the laboratory class activities are affecting your attitude and performance in physics. Kindly respond to the questions according to the instructions to the best of your knowledge. Your responses will be kept confidential. Do not write your name and the name of your school anywhere in this paper.

From question 1 to 3, tick appropriately the correct response.

1. What is your gender?
   Male [ ] Female [ ]

2. Your class:
   Form One [ ] Form Two [ ] Form Three [ ] Form four [ ]

3. Do you find physics laboratory class lessons interesting and motivating?
   Yes [ ] No [ ]

4. Below are list of challenges most likely encountered in a laboratory class lesson. Put a tick to those you face in your school:
   a) Insufficient laboratory equipment [ ]
   b) Lack of exposure to practical examination [ ]
   c) Faulty apparatus [ ]
   d) Blocked sinks [ ]
   e) Faulty gas systems [ ]
   f) Any other (specify)..............................................................................................................

5. In your opinion, what can be done to remedy some of the challenges you have identified in (4) above?..............................................................................................................
...............................................................................................................................................

Thank you.
Appendix V: Interview Schedule for Principal

a) How do you rate the performance of physics in your school based on the available resources?

b) How do you ensure the right level of availability of laboratory physics resources in your school?

c) How often is it possible for you to oversee the physics laboratory class lessons?

d) What measures have you put in place for dealing with unforeseen cases of accidents occurrences?

e) What are the challenges facing the performance of physics in your school?

f) What could be the possible remedies in your opinion to the challenges in e) above?

Thank you Sir/Madam
### Appendix VI: Observation Schedule

<table>
<thead>
<tr>
<th>Item</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Physics laboratory organization</td>
<td></td>
</tr>
<tr>
<td>(i) Apparatus</td>
<td></td>
</tr>
<tr>
<td>(ii) Chemicals</td>
<td></td>
</tr>
<tr>
<td>(iii) Practical lab preparation</td>
<td></td>
</tr>
<tr>
<td>b) Learners level of interest during a physics laboratory class lesson</td>
<td></td>
</tr>
<tr>
<td>c) Safety devices</td>
<td></td>
</tr>
<tr>
<td>d) Requisition documents</td>
<td></td>
</tr>
</tbody>
</table>
Appendix VII: Budget Allocation

<table>
<thead>
<tr>
<th>No.</th>
<th>Item Description</th>
<th>Sub-Total</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Proposal writing</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Desk Research, from various libraries</td>
<td>3,000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stationary, Computer, Photocopy, Printing</td>
<td>3,200</td>
<td>6,200</td>
</tr>
<tr>
<td></td>
<td>and Binding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Research Instruments</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Questionnaires(Typing &amp; Copies)</td>
<td>2,000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Discussion Guide</td>
<td>1,000</td>
<td>3,000</td>
</tr>
<tr>
<td>3.</td>
<td>Data Collection</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hiring of 2 research assistants@ 3,000</td>
<td>6,000</td>
<td>6,000</td>
</tr>
<tr>
<td>4.</td>
<td>Data Analysis (SPSS)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Data Analysis</td>
<td>7,000</td>
<td>7,000</td>
</tr>
<tr>
<td>5.</td>
<td>Final Draft Printing and Binding</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Typing, Photocopy, Binding</td>
<td>10,000</td>
<td>10,000</td>
</tr>
<tr>
<td>6.</td>
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## Appendix VIII: Time Frame

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Appendix IX: Letter of Introduction

Department of Education Management,
Policy and Curriculum Studies,
Kenyatta University

Dear Respondent

Re: Request for Research Data

I am a post graduate student at Kenyatta University. I am conducting research on “The effect of laboratory management on students’ performance in physics in public secondary schools in Bomet County, Kenya.” You have been selected to participate in this study. Kindly assist by responding to all the items in the questionnaire. You are assured that the information you give will be for research purpose only and your identity will be treated with confidentiality.

Your cooperation will be highly appreciated.

Yours Faithfully,

Ronoh Kipkirui Willy
Appendix X: List of Sampled Schools

1. Kimuchul Mixed
2. Kaboruso Boys
3. Kabungut Boys
4. Ndaweta Girls
5. Siongiroi Girls
6. Simoti Mixed
7. Kimulot Boy
8. Kyogong Mixed
Appendix XI: Research Approval Letter

KENYATTA UNIVERSITY
GRADUATE SCHOOL

E-mail: dean-graduate@ku.ac.ke
Website: www.ku.ac.ke

FROM: Dean, Graduate School
TO: Mr. Ronoh Kipkirui Willy
     C/o Educ. Management, Policy & Curriculum Studies Department

DATE: 28th April, 2016
REF: E55/KERI/CE/28654/13

SUBJECT: APPROVAL OF RESEARCH PROPOSAL

We acknowledge receipt of your Research Proposal after fulfilling recommendations raised by the Graduate School Board of 30th March, 2016.

You may now proceed with your Data collection, subject to clearance with the Director General, National Commission for Science, Technology & Innovation.

As you embark on your data collection, please note that you will be required to submit to Graduate School completed Supervision Tracking Forms per semester. The form has been developed to replace the Progress Report Forms. The Supervision Tracking Forms are available at the University's Website under Graduate School webpage downloads.

SUPERVISORS:

1. Prof. John A. Orodio
   C/o Department of Educ. Management, Policy & Curriculum Studies
   Kenyatta University

2. Dr. Gabriel Madanja
   C/o Department of Educ. Management, Policy & Curriculum Studies
   Kenyatta University
Appendix XII: Research Authorization Letter

KENYATTA UNIVERSITY
GRADUATE SCHOOL

E-mail: kubps@yahoo.com
dean-graduate@ku.ac.ke
Website: www.ku.ac.ke

P.O. Box 43844, 00100
NAIROBI, KENYA
Tel. 020-8704150

Our Ref: E55/KER/CE/28654/13
Date: 28th April, 2016

Director General,
National Commission for Science, Technology & Innovation
P.O. Box 30623-00100,
NAIROBI

Dear Sir/Madam,

RE: RESEARCH AUTHORIZATION
MR. RONOH KIPKIRUI WILLY - REG. NO. E55/KER/CE/28654/13

I write to introduce Mr. Ronoh Kipkirui Willy who is a Postgraduate Student of this University. He is registered for a M.Ed. degree programme in the Department of Educational Management, Policy & Curriculum Studies in the School of Humanities & Social Sciences.

Mr. Ronoh intends to conduct research for a project entitled, “Effect of Laboratory Management on Students’ Performance in Physics in Public Secondary Schools in Bomet County, Kenya.”

Any assistance given will be highly appreciated.

[Stamp: KENYATTA UNIVERSITY]

[Signature]

MRS. LUCY N. MBAAB
DEAN-GRADUATE SCHOOL
Appendix XIII: Research Authorization Letter from NACOSTI

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Ref. No. NACOSTI/P/16/86050/11711

Date: 5th July, 2016

Ronoh Kipkirui Willy
Kenyatta University
P.O. Box 43844-00100
NAIROBI.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on “Effect of laboratory management on students’ performance in physics in public secondary schools in Bomet County, Kenya,” I am pleased to inform you that you have been authorized to undertake research in Bomet County for the period ending 4th July, 2017.

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

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

Boniface Wanyama
FOR: DIRECTOR-GENERAL/CEO

Copy to:

The County Commissioner
Bomet County.

The County Director of Education
Bomet County.
Appendix XIV: Research Permit

[Image: Research Permit Document]
Appendix XV: Research Authorization Letter from Ministry of Education Bomet County

Republic of Kenya
Ministry of Education
State Department of Basic Education

Telegram: “ELIMU”,
Telephone: 052-222265
When replying please quote
EMAIL: redebometcounty@gmail.com
Ref: CDE/BMT/ED/AUTH/VOL1/45

COUNTY EDUCATION OFFICE,
BOMET COUNTY
P.O. BOX 3,
BOMET.

8th July, 2016

RONOH KIPKIRUI WILLY,
KENYATTA UNIVERSITY,
P.O BOX 43844-00100,
ELDOROT.

RE: RESEARCH AUTHORIZATION:

Reference is made to the letter dated 5th July, 2016, Ref: NO.
NACOSTI/P/16/86050/11711 from the National Commission for Science, Technology and Innovation.

The above mentioned person is authorized to carry out research on “Effects of Laboratory management on students’ performance in physics in public secondary schools in Bomet County, ‘Kenya’ for a period ending 4th July, 2017.

This letter should be presented to the head teacher of a school visited for the said purpose.

WILLIAM SUGUT
COUNTY DIRECTOR OF EDUCATION
BOMET COUNTY

CC
TSC COUNTY DIRECTOR
Appendix XVI: Research Authorization Letter from Bomet County Commissioner

OFFICE OF THE PRESIDENT
MINISTRY OF INTERIOR AND COORDINATION OF NATIONAL GOVERNMENT

Telegrams: “DISTRICTER”, Bomet
Telephone: (052) 22004/22077 Fax 052-22490
When replying please quote

REF: EDU 12/1 VOL.I (176)

8th July, 2016

COUNTY COMMISSIONER
P.O BOX 71
BOMET - 20400

All Deputy County Commissioners
BOMET COUNTY

RE: RESEARCH AUTHORIZATION – RONO KIPKIRUI WILLY

The above named person has been authorized to carry out research on “Effect of laboratory management on students’ performance in physics in public secondary schools in Bomet County, Kenya,” for the period ending 4th July, 2017.

Any assistance accorded to him would be appreciated.

Henry Metto
For: County Commissioner
BOMET COUNTY

c.c.

Hellen Lucy Gesare Omanghi
Moi University
P O Box 3900-00100
ELDORET