ASSESSING EFFECTIVENESS OF TEACHING AND LEARNING FACILITIES OF PHYSICS AMONG FORM TWO STUDENTS OF GEM DISTRICT, SIAYA COUNTY-KENYA

By

John Odhiambo Otiato

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November 2011
Declaration

“This report is my original work and has not been presented for a degree in any other University or for other award”.

Student’s Name John Otiato Odhiambo

E55/OL/15846/2005

Signature………………………………….Date……………………………………

Supervisors:

This report has been submitted for review with our approval as University supervisors.

1 Dr J. A. Shiundu
   Lecturer
   Kenyatta University,
   Department of Educational Management and Curriculum Studies

Signature………………………………….Date……………………………………

2 Mrs. Lillian .C. Boit
   Lecturer
   Kenyatta University,
   Department of Educational Management and Curriculum Studies

Signature …………………………………………..Date …………………
Dedication

This work is dedicated to my daughters Cassidy,

Elsie and Caroline.
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Abstract

The purpose of the study was to assess the effects of teaching and learning physics facilities on physics performance in secondary schools. The study was conducted among form two students of the public secondary schools of Gem District. The area of study was limited to randomly sample secondary schools in the district. The results of other studies, Sobolewski (1993) and Todd et al (2003) have hinted that physics is perceived as a difficult subject and is being evaded by students and teachers. Preliminary study revealed that in some schools physics is technically compulsory, while in others it was a voluntary subject. There were indications that many students avoid physics due to some reasons, school or personal or lack of resources. The study developed six hypotheses to establish whether there was significant relationship and difference in performance in physics based on teaching and learning physics with facilities by gender, attitude and age. The study design was pretest-posttest experimental control group design based on teaching and learning physics with facilities using the three major tools for data collection, the gathered data was analyzed by use of computer package SPSS Program. The results of the study were statistically presented in the form of t-statistic and Pearson’s r correlation coefficient for difference and relationship respectively. The study revealed that there was significant relationship between student’s performance and use of physics facilities, which showed significant improvement in student’s mean performance in physics and improved attitudes toward the subject. The study found that performance improved among the experimental more than control group. However, control group performance improved due to side effects. Further results showed that there was no significant difference in performance by gender when teaching was based on theory and practical, showing that treatment administered on experimental group could improve enrolment and performance in physics. Finally, analysis on results revealed that there was significant difference in performance between experimental and control groups by attitudes toward physics concluding that teaching and learning of physics improved with use of facilities.
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<td>AIDS</td>
<td>Acquired Immunodeficiency Diseases Syndrome</td>
</tr>
<tr>
<td>EAPL</td>
<td>East African Power and Lighting</td>
</tr>
<tr>
<td>ECK</td>
<td>Electoral Commission of Kenya</td>
</tr>
<tr>
<td>FPE</td>
<td>Free Primary Education</td>
</tr>
<tr>
<td>GAP</td>
<td>General Pass Aggregate</td>
</tr>
<tr>
<td>HIV</td>
<td>Human Immunodeficiency Virus</td>
</tr>
<tr>
<td>ICPE</td>
<td>International Commission on Physics Education</td>
</tr>
<tr>
<td>ICT</td>
<td>Information Communication Technology</td>
</tr>
<tr>
<td>IIEC</td>
<td>Interim Independent Election Commission</td>
</tr>
<tr>
<td>KCSE</td>
<td>Kenya certificate of Secondary School</td>
</tr>
<tr>
<td>KRA</td>
<td>Kenya Revenue Authority</td>
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<tr>
<td>MDGS</td>
<td>Millennium Development Goals</td>
</tr>
<tr>
<td>MOES&amp;T</td>
<td>Ministry of Education Science and Technology</td>
</tr>
<tr>
<td>OECD</td>
<td>Organization of Economic Cooperation and Development</td>
</tr>
<tr>
<td>PGDE</td>
<td>Post Graduate Diploma in Education</td>
</tr>
<tr>
<td>SMASSE</td>
<td>Strengthening Mathematics and Sciences in Secondary Education</td>
</tr>
<tr>
<td>SPSS</td>
<td>Statistical Package of Social Sciences</td>
</tr>
<tr>
<td>TIQET</td>
<td>Totally Intergraded Quality Education and Training</td>
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<tr>
<td>UNESCO</td>
<td>United Nations Educational, Scientific and Cultural Organization</td>
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CHAPTER ONE: INTRODUCTION

Physics is an experimental science and practical work should therefore play an important role in the teaching and learning at all levels. Perhaps the goals of taking experiments was not being achieved due to certain elements that influence the teaching and learning of physics in secondary schools, making the subject become unpopular among the science subjects that are being taught in secondary schools. The study assessed effectiveness of facilities for teaching and learning of physics in public secondary schools. The work was achieved through experimental and descriptive approaches.

1.1 Background to the Study

The challenges for the growth of Kenya’s economy and industrialization as a basis for self-reliance are yet to be overcome since 1964 when Kenya attained her independence. For development, the government’s policies mostly concurs with the views of the presidential appointed commissions (Working Party) on how improvement on education and training in the coming decades and beyond should be utilized to provide appropriate skilled manpower required by the national economy, (Gachathi, 1976). To achieve this, the Ministry of Education Science and Technology (MOES&T) has put in place curriculum to emphasize development of technical colleges in Kenya. The curriculum has the emphasis on the teaching and learning of physics because physics is one of the science subjects, which is practical oriented for promoting growth of individual’s towards maturity and fulfillment of useful and well-adjusted scientists of the society.
The Kenya Education Commission report chaired by Ominde (1964) made recommendations for technical secondary schools to provide some introductory experience of workshop technology; this was a concern with basic subjects, like physics, mathematics, and chemistry. Hence, secondary school curriculum was designed to ensure effective coverage of its content and to assist in strengthening career orientation (Session Paper No 6 of 1988), this was expected to give students the experiences; concepts and understanding on the subject for achievement.

Kenya Institute of Education (K.I.E) Report No. 6 of May 1989, and Secondary Education Investments Program (2005-2010), outline the issues and constraints on education enrolment. The document mentioned the decline in enrolment due to many factors affecting teaching and learning of physics. Some of them are high cost of learning and teaching materials, extra expenses for science laboratory and negative effects of HIV-AIDS pandemic. However, despite the government decrees on science education, there is still evidence that most schools are evading physics because of teaching and learning facilities for physics, coupled with negative attitude by teachers and students towards the subject resulted to poor performance and low enrolment. Schools experience the difficulties in the context of either practical or theoretical situation and the study was to assess the conditions to obtain a solution and recommendations for the same. However, a pilot program (SMASSE, 2006) in the district revealed that schools were lacking necessary basic facilities for effective teaching and learning of physics.

### 1.2 Statement of the Problem
The study was assessing physics teaching and learning facilities to determine the relationship and difference in performance among form two students based on available facilities in public schools of Gem District.

Although there are several methods used to teach physics, low enrolment among secondary schools has persisted. Kenya Institute of Education Evaluation Report (1995) noted that few students in form two chose to continue with physics, which eventually resulted in limited trained physics teachers and physicists to supply technical services. Though Physics Laboratories exist in secondary schools, the situation on Gem District secondary schools enrolment for physics revealed that they lacked facilities and adequate personnel to improve teaching and learning for sustenance of students’ enrolment in the study. Other studies (Obanya, 1985) revealed that physics is a subject with several teaching and learning methods but it is usually the most disliked of the natural sciences with low enrolment. Parent Teachers Association Reports (2008/9) indicated that in some schools such as Sawagongo High School and Moi Girls, Ekdoret, the subject had either become technically compulsory or optional. Views based on information in these reports hinted that the subject had high dropout rate for fear of poor performance due to lack of proper teaching and learning methods for sustaining student’s interest in the study. Based on the views and nature of the subject, the researcher set to assess effectiveness of methods used in teaching and learning of physics by experimental study based on pretest-posttest control group design.

1.3 Purpose of the Study
The study on teaching and learning physics based on physics facilities was conducted among form two students to provide information on student’s performance and attitudes toward physics. The results of the study were to assess whether there was significant relationship and difference in performance in the subject by gender and age. The purpose of the study was to provide results that would be useful to education administrators on planning and budgeting for the teaching and learning activities in public secondary schools. The study was also expected to determine whether there was significant relationship and difference in physics performance between experimental and control groups on available physics facilities.

1.4 **Hypotheses**

Hypothesis is considered the principal instrument in research to provide inferences from research data.

The study used hypothesis for statistical testing to investigate whether there was difference and relationship between student performance in physics when teaching and learning was based on physics facilities. The study used six null hypotheses to assess effectiveness of teaching and learning physics facilities in sampled secondary schools. The following hypotheses were formulated:

**H01:** There is no significant relationship between students’ performance in physics when teaching and learning are based on physical facilities by gender.

**H02:** There is no significant relationship between student’s performance in physics when teaching and learning facilities by age.
H0₃: There is no significant relationship between students’ attitudes towards performance in physics when teaching and learning are based on facilities by gender.

H0₄: There is no significant difference between students’ performance in physics when teaching and learning is based on physical facilities by gender.

H0₅: There is no significant difference between student’s performance in physics when teaching and learning and learning are based on physical facilities by age.

H0₆: There is no significant difference between students’ attitudes towards performance in physics when teaching and learning are based on physical facilities by gender.

1.5 Significance of the Study

The study has both practical and theoretical implications that would help school administration to popularize physics among the students and teachers at all levels. The study assessed teacher’s interests on teaching and learning with facilities and students interests toward physics by gender and age. The study assessed practical implications which would guide school administration lay emphasis on planning for the requirements of the subject. The results of the study would motivate physics teachers to draw management plans for laboratory process to achieve effective teaching and learning of physics.
The other practical implication would be for physics teachers; to develop a sound interpersonal relationship with school administration, students, and the equipment suppliers for urgent acquisition, storage of teaching materials and the development of state of the art laboratory facilities.

This study exposed the weaknesses that have been labeled on the subject, which resulted in negative attitudes on learning of physics such as the expressions that “it is difficult; or it’s a man’s subject”.

The other significance of the study was to adjust the curriculum due to implications of the nature of the subject and to give hints on the necessary improvements for effective teaching and learning of physics in secondary schools. The report would help secondary school administrators understand the nature and practical requirements for physics and would also to form a base on which others could develop other studies in the same line or other subjects of study.

In terms of the theoretical values, the study was hoped to be of significance to the following parties in specific ways:

a) The Developers of Science Curriculum and Policy Makers
   The curriculum developers and policy makers within the ministry will be able to bridge gaps between theory and experimental work for teaching and learning effectiveness of physics and reduce wastage in secondary schools.

b) Education Science and Technology
   The MOES&T through schools will be prepared to refine physics education and its objectives to create awareness of the difficulties that schools undergo when implementing
physics curriculum especially when considering resources available and regional differences.

c) Teachers and Learners

The teachers will get the insight on how to improve the teaching and learning processes that will enable them to advice learners regarding career development with physics. It is hoped that from this report, teachers will be able to easily identify needs for acquiring teaching resources and capacity for motivating learners to stay in the study of physics.

1.6 Limitations and Delimitations of the Study

- Limitations

Access to sample public schools was affected by lack of proper means of transport; the access roads were damaged by bad weather which made transport to schools difficult. The encountered problems on transport limited the study to schools that were situated along the main roads. Lack of finance and time also limited the study to the sample schools only.

- Delimitations

The study was conducted among form two students of public secondary schools in Gem District. The experimental data was organized from a section of the syllabus on electricity and magnetism using the available facilities in the schools. The available secondary data was limited to a period of the last three years.
1.7 Assumptions of the Study

Some of the extraneous factors that could affect the results of the study are assumed that:

i) The teaching and learning of physics alongside other subjects is based on the approved syllabus from form one to form four.

ii) Teacher’s background training and interest on teaching physics is not questionable.

iii) Learners have unquestionable ability to learn the subject.

1.8 Theoretical Framework

The study was based on Vroom’s Expectancy Theory (Vroom, 1964); which states that effort or motivation behaviour occurs when an individual perceives that the effort will lead to effective performance which intern leads to rewards viewed as attractive enough to make the effort seem worthwhile.

According to the theory, the learner’s and society expectations on the development of teaching and learning of physics towards effective outcome depends on facilities provided by school administration. Hence, the effort towards teaching and learning of physics may not necessarily lead to effective performance unless it is assisted by other factors, both individuals and environmental behaviours. It is because expectancy is based on individuals’ perceptions; that helps to explain school and individual differences in motivation and behaviour towards the study and outcomes of physics.
Table 1.1  Theoretical Framework

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<th>Dependant Variable</th>
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<td>Gender influences</td>
<td>Teaching and Learning</td>
</tr>
<tr>
<td>Age</td>
<td>and Subject Popularity</td>
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<td>School Status</td>
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<td>Staff Motivation</td>
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<td>Student Attitudes</td>
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The dependant variables are the activities which depend on the independent variables. The theory showed relationship between teaching and learning of physics with student by gender, facilities, age, school status and attitudes. The researcher would manipulate some of the independent variables; by provision of facilities, motivation and psychometrics for analysis.

1.9  Conceptual Framework

Teaching and learning of physics are activities that depending on available human resources, physical facilities, change of attitudes, motivation and performance which are determined by the “input” as independent variables. The elements of the input are students and teacher’s population and attitudes about physics, motivation, curriculum, and provision of the teaching facilities among others. The “output” is performance coupled with enrolment rate. The “feedback” will be performance and subject popularity.
Figure 1.1 Conceptual Framework on “Teaching and Learning Effectiveness of Physics”

*Source: Adapted from Orodho A. J. (2004), David Easton, (1979), C. Charles (1988) and Lecture Notes, Shiundu and Boit ((2007))

The conceptual framework on teaching and learning of physics, Figure 1.1 explains the interactions between the variable. The teaching and learning is a continuous process which
change with school’s development priorities, classroom process, teacher’s and student’s attitudes. These concepts are interrelated with “feedback” performing the function of continuity or enhancement of the activities. The following are the descriptions and empirical observations of the system:

Teaching and learning; represents the overall perception of a school with adequate resources and classroom size for teaching and learning process with proper time allocation for physics CATs, experiments and Assignments on the subject for improved output.

The school development priorities or school climate: determined student’s and teacher’s interest on the subject. It also determined the level of provision for physics facilities and training offered to staff on the use of physics apparatus, policy, and acquisition of resources for physics.

Classroom processes: this represented activities on teaching and learning of the subject, determined by strategies and practices teachers use in helping students learn. The construct is measured by items relating to the extent to which students apply the theory through experiments, class discussion on practical problems and projects or education tours related to the subject.

Teacher Attitudes on physics: the construct represents teacher career prospect to develop physics and will depend on school plan to towards development of staff and the subject.

Student’s attitudes on physics: the construct reflected student’s interest in physics; measured by enrolment indicating the nature of the subject. This would drive away student’s absenteeism from physics lessons and improve sustenance in studying physics in form three.
The output of the construct was determined by performance; which influenced student’s enrolment for the study (KIE, Research Report No.55 p.53, (1995); and popularizing the subject among other science subjects in public secondary schools.

1.10 Definitions of Operational Terms

**Assessment**
Process in which you make a judgment about a person or situation

**Codebook**
A book compiled by the researcher identifying a specific item of observation and the code number assigned to describe each category included in that item.

**Content Validity**
The extent to which the content of the measuring instrument reflects the concept that is being measured and in fact measures that concept and not another.

**Dropout Rate**
A drop out is the pupil who leaves school/subject before completion of the given stage of education or leaving at some intermediate or non-terminal dropout in a cycle of schooling

**Experiment**
Refers to an investigation in which a factor or variable under test is isolated and its effect(s) measured

**Experimental Group**
In an experimental research design the group of participants exposed to the manipulation of the independent variable; also referred to as a treatment group

**Effectiveness**
Producing the result that was wanted or intended.

**Experience Survey**
The process of developing the ideas through discussions, various new ideas develop through such an experience

**Fear Factor**
State of fear of getting hurt or doing something wrong before students

**Interview Schedule**
Is a set of questions that the interviewer asks when interviewing.
Internal Validity
The evidence required in experiments to rule out possibility that factors other than the independent variables (iv) are responsible for variations in the dependent variable (dv)

Measurements
Is the assignment of labels or numerical to the properties or attributes of observations, events or system

Measuring Instrument
Instruments such as questionnaires or rating scales used to measure the variables in a research study

Meta-analysis
A research method in which mathematical procedures are applied to the quantitative findings of studies located in the literature search to produce summary statistics and to describe the finding for the meta analysis

Noncontrolled Observation
A rather flexible observational method in which samples are rarely taken and which is often associated with quantitative research

Observation Checklist
A method of data collection in which people are observed in the natural environments using specified methods and measurement procedures example Direct observation which is entirely on physics behavior and the observer remains a part from the group or persons being observed.

Pretest
Measure of the dependent variable prior to the introduction of the independent variable

Posttest
Measure of the dependent variable after the introduction of the independent variable

Predictive Validity
Refers to the usefulness of a test in predicting some future performance.

Probability Sampling
Is known as random sampling or chance sampling. Under this design, every item of the universe ha equal chance of inclusion in the sample or $^N\text{C}_n$ possible samples has the same probability

Research Design
Is the preparation of the design of the research project. This includes the decisions regarding what, where, when, how and how much and by what means concerning the study.

**Research Instrument**
Is standardized through research procedures, which are aimed at empirically varying its characteristics results and applicability, instruments such as questionnaire, or rating scales, are used to measure the variables in a research study.

**Survey Method:**
The use of questionnaires or interviews to collect data about the characteristics, experiences, knowledge, or opinions of a sample or a population.

**Test:**
Any structured performance situation that can be analyzed to yield numerical scores, from which inferences can be made about how individuals differ in the construct measured by the test.

**Test-Retest Technique**
Is a method of assign reliability of data involves administering that same instrument twice to the same group of

**Test-Retest Reliability**
Reliability of measuring instrument established through repeated administration to the same group of individuals.

**t-Test**
A hypothesis test that uses the t-statistic and t-distribution to determine whether to reject or retain the null hypothesis.

**Validity**
 Appropriateness and usefulness of the specific inferences made from the test scores. The accuracy and meaningfulness of inferences, which are, based on the research results.

**Wastage**
In respect to the subject, it refers to human and material recourse or “wasted” on student or on student time to enroll for a subject then dropout before completing cycle. It denotes the efficiency of a school system and refers to the wasted opportunities for the players to develop the knowledge, skills and attitude and values they needed to live productive life.
CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

The study on the “Assessment of Effectiveness of Teaching and Learning Facilities for Physics in Secondary Schools of Gem District” was necessary in accordance with the Ministry of Education Science and Technology Draft April 15th 2005, Chapter 17, which outlines the issues and constraints on education enrolment in secondary schools. Physics is an essential subject being taught in secondary schools aimed at creating long-term change to the learners' perception and understanding of the world around them. In the current trends of modernization the physics concepts as a science subject are important parts for human’s development and sustenance of technology. However enrolment for physics is low in secondary schools. Naturally fewer students enroll in physics than other science subjects (Bennaars, 1993). The purpose of this experimental/descriptive study is to assess the relationship and difference of the variables, which influence teaching and learning effectiveness of physics in secondary schools.

2.2 Learning of Physics

According to the Ominde (1964), the Kenya Government was concerned with the improvement of education especially science from independence era. In it’s recommendation No. 240 p.75-76 was a proposal on secondary school technical experiences of workshop technology, and it was concerned with subjects from basic to higher technological studies.
notably physics, mathematics and chemistry. In the other presidential reports in education and manpower training (J.M Kamunge, 1988) emphasized on rapid development and expansion of technical education and training, but since independence the trend has been affected by lack of facilities.

According to Kamunge report, the development of education was rapid resulting into high enrolment, but the cost of the technical facilities for management of the teaching and learning remained extremely high. Also the implementers were concerned with the challenges, which included cost of the facilities, inadequacy of the skilled teaching and technical staff for laboratory experiments and change of attitudes towards the subject.

It was noted that few students in form two choose to continue to pursue the study of physics, which eventually results in the limited trained physics teachers, scientists, and gradually retards the development of physics-based courses, (KIE Evaluation Reports, 1995). As a result of the problems, the proportion of students’ enrolment and sustenance for physics up to Kenya Certificate of Secondary Education (KCSE) has been low due to its dropout rate in form two (Bogonko, 1992).

Physics is a subject that requires both theory and practical aspect of teaching, however in most secondary schools there are limitations to each aspect of teaching approach. The teaching by lecture method has disadvantages to the students; they consider the subject to be very difficult that involves cramming equations and formulae, the method is affected by lack of reading materials and lack of teaching personnel.

On the other hand teaching through experiment has a number of problems encountered, problems as lack of teaching facilities, lack of professional staff to assemble and demonstrate
the experiments and there is also shortage of teaching expert to conduct the experiments to encourage students’ choice to continue in the study of physics. According to Chitwa and Njunge (2004) many science teachers complain about lack of teaching and learning resources for physics. And according to Ouko (2004), lack of essential teaching and learning resources such as laboratories, teaching materials, and textbooks contribute to low enrolment and poor performance.

SMASSE project advocated for improvisation and scaled down experiments. Hence the baseline study showed that most teachers do not cover the syllabus by the end of every year, especially physics, and therefore students who do physics are not well prepared for creativity (SMASSE, 1998). According to Eaders J.A (1976), the teaching with experimental work in physics education improves the teaching and learning of the subject.

As physics theory advances and equipment required for experiments become more complex creating a tendency of withdrawal from conducting experiments both the teachers and students loose the interest in the subject resulting in low enrolment. This virtually affects teaching and learning of physics.

According to Sobolewski (1993) the study of the United State (USA) High schools, on teaching and learning physics, revealed that variable as school facilities, community attitudes and teachers years of experience in teaching physics, supports the physics enrolment. Further the authors of the article Todd VanGordoen and Tim Slater (2009) identified factors influencing enrolment of physics classes in Kansas high school of US as teachers, teaching facilities, and the community.
At a conference UNESCO (1976), it was mentioned that when adjudicating the equipment for purchase most school administration have fear factor for lack of confidence on experiment procedures with the apparatus, the cost of equipment and lack of skilled technical operators simply to avoid the improvement of the subject.

Although some laboratory work may be directed toward particular skills in certain branches of physics, for example electronics, in general becoming relatively of less importance to be attracted in schools due to the nature and cost of the equipment and staff involved, (J.A. Eaders for Edinburgh UNESCO, Conference).

In most cases schools go for smart and expensive school buses instead of laboratory apparatus like traveling microscopes, cathode ray oscilloscope, power supply etc. it is a practical experience that; most school administration when adjudicating the equipment for purchase avoids physics apparatus, Neuschartz and Covalt (1988) reported that in United States between 1986-87 schools year 18% of American High School rarely or never taught physics due to lack of teaching facilities. It had an implication that US may develop severe shortage of engineers and scientists, and may limit US competitiveness in Global Sciences and Technology for the twenty-first century. Hence he agrees that only a few studies have been conducted in US to determine physics enrolment influences.

In Kenya, the report by Koech (1998); the commission observed that as a result of insufficient financing; coupled with the increased student population due to the high demand for university education, influenced the teaching and learning effectiveness of physics in secondary schools. It also recommended that the exact subject selection be independent on the prevailing resources and facilities at the school (TIQET 15, 26 P. 292, 1998).
2.3 Enrolment for Physics

Pupils joining secondary school have no prior knowledge or idea on physics (Todd VanGorden et al. 2009), (Pittsburg State University, 1993) yet, they are aware of other subjects as mathematics, history, geography, Christian Education and general science.

According to Todd VanGorden et al (2009), his results showed that major factors affecting student’s enrolment in secondary school physics is student perceived behavior and need to enroll because of the positive view and reputation of the teacher. Hence, students take all subjects including physics but gradually drop it in form two.

*Table 2.1 Sample Enrolments for Physics (2002)*

<table>
<thead>
<tr>
<th>School Level</th>
<th>Agoro Sare</th>
<th>Ngere</th>
<th>Sawagongo</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form One</td>
<td>84</td>
<td>115</td>
<td>150</td>
<td>349</td>
</tr>
<tr>
<td>Form Two</td>
<td>41</td>
<td>114</td>
<td>149</td>
<td>304</td>
</tr>
<tr>
<td>Form Three</td>
<td>25</td>
<td>21</td>
<td>39</td>
<td>85</td>
</tr>
<tr>
<td>Form Four</td>
<td>25</td>
<td>21</td>
<td>35</td>
<td>81</td>
</tr>
</tbody>
</table>

*Source: Research School of Graduate Studies, Maseno University, (2002)*

Research Study Maseno University (2002), the enrolment for other subjects is over 60%, of students compared to that of physics, which is approximately 20% in upper forms. The drop out is 70% in form three.

Other factors significantly affecting enrolment is conflicting schedules of needs required or prerequisite background knowledge may prevent some students from enrolling for physics.
According to Oyoo (International Journal pp.169-184, 2008), there is evidence of teachers approaching to use the physics terms; language at early or introductory stages of teaching, this may contribute to making the learning of the subject concepts more difficult for many students. In order to control the fear, physics teachers should be trained how to teach physics. According to some secondary schools, physics is compulsory, PTA reports show that every candidate takes between 7 and 9 subjects which are selected from compulsory category groups A and B. In these groups are (A) English, Mathematics, and Swahili (B) Biology, Chemistry and Physics in (C) and at least 2 from the arts subjects (Moi Girls, 2009). While in other school it is optional. The mentioned problems affect the schools from developing effective physics education. Therefore attrition rate is very high in the second years of study limiting the number of students enrolling for technical education and university engineering courses.

According to Finkelstain (2008), there is a critical shortage of teachers and lack of diversity at university level. This intern resulted into less trained teachers for secondary level. According to the KIE Reports, No 55 of 1995 there was abundant evidence of inadequate supply of equipment, apparatus and other materials for teaching and learning of physics (Research Report Series No 55 p.53) resulted into negative attitudes for both the teaching and learning of the subject.

Commission’s Report on education and manpower training (J.M Kamunge, 1988), emphasized on rapid development and expansion of education and training, since independence that was attributed to factors of peace and stability in the country. It is at this juncture that it should become clearer that communities, parents, religious and private
organizations have contributed greatly towards the provision of education facilities. It was realized that, it is mainly through education and the establishment of good infrastructure in various areas of education and training the country could attain the economic growth, but the government had issues about the rising costs in the financing of education and training. The move was not applicable to some subjects especially physics. The cost–sharing between government and community, the expansion of science education, training and research became costly for the society.

In a study Khan and Weiss (1973) and Ormerod M. (1975) concluded that the role of teacher is important in the development of both the subject and students effective behavior over education. Efficiency style and personality of science teachers can affect students’ attitudes toward science.

2.4 Learner’s Attitudes on Physics

One of the underlying requirements to follow physics is the formation of attitude and development of the mind towards the learning principles of the subject, (McGuire, 1985). However, according the KIE report No 6 of May 1989, sec 3.2.3 mentions that students have difficulties with some physics topics due to difficult calculations, inadequate apparatus for experiments, the syllabus is not well organized, and students have a poor background of the subject. In addition to this teachers have inadequate training on how to teach physics. Although some students enter the study of the subject holding well-defined attitude toward physics that it is a difficult subject, but from the environment, persons seen doing physic are termed genius.
Development of the subject and student’s effective behavior in the study and personality of the teachers can affect attitudes towards physics (Khan and Weiss, 1973). It is observed that what we learn and how we learn it is closely tied to our attitude about the school and the subject, (Bell, 1980). According to Koech (1998), the average class size recommended was 35 students, currently the class size is approximately 50 students and above as opposed to the recommended Pupil Teacher ratio (PTR) of 35:1.

Robinson (1991) found that teachers should first change their attitudes about having a wider range of students enrolling. However, in the report by Robinson (1991) he recommends more effective physics instructions and laboratory activities that are attractive to a wider range of students enrolling, but concentrate in the development of both theory and practical parts of physics. He recommends that the courses should be made relevant to students’ lives by incorporating the strategies of teaching and learning with the use current events of technologies. These should be, via the magazines television and newspapers. This means that the attitude and subject are learned simultaneously through complex interactions.

According to Crawley and Black (1992), students in Texas have enrolment intentions that are determined by their attitude towards enrolment and their degree of perceptual behavioral control, grade level and career goals and family members were found to influence students’ attitude towards the subject.

The researcher agreed that student’s attitude determines what they learn, their willingness to learn the subject and the application of the subject as seen in the society, John and Lewis (1976) and White et al (1997).
According to Majerei Stanley, (2007) his findings agree with that of Crawley and Black et al, popular role models in the society determine students’ perception and attitudes toward the usefulness of the subject. He had positive relationships between teaching instructional rating and students’ self-concept of usefulness of physics.

Influencing enrolment in Kansas High School physics US, (Todd et al, 2003) supports the recommendations by Grote (1994) and Robinson, the attitude, subject expertise and reputation of physics teacher are virtually important in the attraction of secondary school students to physics. Physics teacher and (essentially all teachers) must be aware of the direct influences they have on enrolment and interest in their courses. These influences must be addressed to prevent many talents fall shortages in science careers. The country Kenya must be capable of competing in changing global society. However, other problems encountered affecting the effectiveness in the teaching and learning of physics are the attrition rate, wastage, and the negative effect of HIV/AIDS (Ministry of Education, 1995), and (Bogonko, 1992)

2.5 Motivating Learners to Study Physics

In order to enhance enrolment and popularize physics, there is need to create awareness to motivate learners to enroll and continue in the course. It is noted that the dropout rate in physics in Kenya’s secondary schools has been running as high as fifty percent, Eshiwani (1982). Hence, the subject is feared and being evaded by students, teachers, schools as well as parents as a result students are likely to miss admission in engineering courses being offered at university and technical institutions. Certainly, that opens a question if Kenya is able to attain the Industrialization target.
The research project (SMASSE 2006) mentioned that physics is easy to teach especially modern physics but most of the teaching and learning process is done mostly through theoretical approach. SMASSE; explained that it is due to high cost of equipment and lack of properly trained personnel to use the already acquired equipment. It is noted that some equipment is available in schools, for example ripple tank, optic, bench, Cloud chamber, Scintillater etc but no physics teacher tries the teaching by experiments simply for lack of competence on the required procedure This prevents the development of the subject.

Sobolewski (1993) reviewed educational data from schools in New York State and considered variables of school facilities, community size, teacher’s years of experience and educational background to influence physics enrolment. Comparing this result to Kenyan education today, the variables remain the same, however an extra variable featuring mostly creates a need to compare the rewards gained through physics education and that of those without physics; for example the Judiciary personnel, comparing the rewards, those with humanities end in lucrative positions than those with physics education.

There is a fundamental uncertainty in education today, the question is, why teach physics? Instead of asking how should physics be taught; (Eaders.J.A, 1976) states, “In some countries the answer is to prepare students for entry to university”. Nevertheless, there is concern of the minority of children enrolling for physics and the answer is no longer acceptable. In the case of Kenyan secondary schools, “they do not use physics education to prepare students for university entry”. Eaders.J.A. et al, (1976).

We have to recognize that physics is an integral part of human culture and that it should be presented in this context. It is therefore important that every citizen has some appreciation of
science, its methods and limitations. If the attitude of citizens toward physics is to be helpful, physics must be taught as a human activity, which is seen to have relevance to the individual in his social environment.

Grote (1994) suggests giving cards or notes to students for birthdays, complementation and before athletics or academic competitions. Students are likely to respond with interest. His results support Ormerod and Duck Worth (1975) in which the role of the teacher is an important factor in student’s attitudes toward science. The report listed the following

i) Students who know the subject teacher are likely to enroll in physics than those who do not.

ii) Teachers with good reputation throughout the school will likely attract students to physics or any other subject taught.

Grote also reports on the importance of showing care for students. He recommends to each teacher to find methods of showing students that he or she cares fitting his or her own personalities.

The study was consistent with Sobolewski (1993) “Factors Influencing Enrolment in Kansas High School Physics”. The experience of a teacher was found to be latent variable influencing physics enrolment. Furthermore classroom activities can be related to students’ hobbies and interests, such as physics insights at the basketball games or give problems related to student’s interest.

2.6 Impact of Physics on Technology

In evaluating the place of technology and national development, it is obvious that we cannot ignore the role of physics education. Every man or woman needs the science of physics to
perform work; other subjects like chemistry and mathematics share units, teaching methods, and even application with physics, but learners still tend to run away from doing physics in favor of other sciences subjects.

The demand for this knowledge of physics increased gradually for industrialization and the need became higher during and after the first and the Second World Wars. It was the period when the world needed scientific weapons, means of communication, industries, transportation etc.

There was also political element, where the education, training and research should provide skills and appropriate technology for effective development; this needed the development of physics education and to follow the recommendation of the 8-4-4 system which was to equip school leavers with skills that enable them to live and positively contribute towards the development of their society and environment.

The building of technology in Kenya is imported; this includes factory machinery immediate goods for further processing consumer goods including physics equipment and simple apparatus. However, the development could not be realized without developing physics. The government also saw the need to create various employment opportunities through rural industrialization and an accelerated development of infrastructure and public amenities in order to attract and retain the majority of school leavers in the rural areas.

The demands for efficient working devices became a necessity to foster development for every mankind and this gave rise to the development of formal learning of physics, while before they were operating in the informal or non-formal learning. With the emergence of the
Information Communication Technology (ICT) physics has played important role in the development of computers, communication facilities and banking interface facilities.

Physics, as a source of knowledge, has been used to change human's life for development and its study was achieved through the; geographical or environmental, social and chronological approach. Various people have different models to demonstrate that physics contributes directly to economic growth by improving the skills, attitude and productive capacity of labor.

2.7 Teachers’ Views on Teaching and Learning of Physics

According to the evaluation report, it clearly indicates that students are not well prepared for all aspects of 8-4-4 system (K.I.E, Objective Report Series No 53 p. 45), including preparation for further studies. Students’ perception on how well various subjects were taught show that physics was 15.74% well taught.

According to the KIE Report (Nov 1995), 27% of secondary school teachers were untrained in 1993. There was evidence to show that by 1993, no subject had fully trained teachers. The worst hit subjects were Physics, English and Mathematics. Many Headteachers, and teachers who responded indicated that these subjects were being done poorly because of lack of qualified and inadequate number of teachers.

The KIE Report No. 52 of 1989 indicated that there was a near adequate provision of classroom, which was 44.0%, but the situation as regards physics laboratories or workshops and libraries was not good. Hence, without considering the element of experiment work then, imagine teachers whose ideas and beliefs about teaching and learning is solely that the teacher gives and that the learner receives only that which the teacher gives without means to
enhance understanding of the topics. Tabanara (1995), shows that if a teacher’s understanding in certain topics i.e. electricity is very poor; he/ she avoids laboratory work, rejects any form of student discussion and uses no examples. In such situation the teacher does not use analogies because they do not understand their significance themselves. Students would see the teacher’s role solely in terms of organizing a clear and logical exposition and ensuring that students master only what they are told.

It is noted that some equipment are available in some schools but no physics experiment is attempted for teaching and learning simply for lack of technical competence on experimental procedures (SMASSE, 2006). Hence, their classroom practice is limited to lecture taken from texts and demonstration of solutions and standard quantitative problems. In such cases the teachers would have attitudes and behavior in the classroom that is extraordinarily negative towards other methods of teaching and learning of physics. Students would see the teachers’ role in terms of organizing the theory only. According to Eaders S.A (1976), physics as experimental science, practical work should therefore play an important role in teaching and learning of the subject at all levels.

2.8 Summary

Physics laboratory is usually an environment set aside specifically for studying the subject practically. The responsibility of the teacher in the laboratory is the actual use of available space and materials to facilitate learning and teaching. Here in the work of the teacher falls into three categories; demonstrating, coordinating and discussing the observed phenomena (Obanya, 1985). As such the need to review on the effectiveness of teacher training program for physics teachers should be emphasized. For example the Bachelor of
Education (Science) should have emphasis on methods with practical for teaching physics in secondary schools. The work would be important to improve teachers’ effectiveness in teaching physics at all levels.

It has been observed that the image of physics and mathematics have been exceptionally for intelligent students; and it is easy for a learner to get discouraged from the study at higher level of introductory stage, therefore physics principles should be mentioned early in upper primary schools, secondary schools to continue the teaching and learning by reading, discussion with experiment and out of class activities. The idea is that, the subject should not remain the way it is, but there should be necessary linkages for popularizing the subject. It is important to establish the point from where learners miss essential steps, making it very difficult to catch up at later stages. Since the subject is difficult at higher levels of study, and yet no steps are considered then it would even be too late if students’ interest to study physics were reawakened. While in this subject, the introduction of middle courses, diploma, bridging courses and the postgraduate diploma courses in physics would be a solution.
CHAPTER THREE: METHODOLOGY

3.1 Introduction

The study was to assess teaching and learning effectiveness of physics facilities in secondary schools of Gem District. The teaching and learning of physics can be achieved through methods as persuasion, reading with experiments and observations, discussion and out-of-class activities. The project involved identified sample schools for teaching and learning with experiments. The process of teaching and experiment were done by teachers as expected to enhance students’ understanding and develop their interest towards the study of physics. The researcher used Pretest-Posttest-Control group design for the study; the design provided valid and reliable research results to serve as additions to the theoretical knowledge about the subject. The study collected continuous data where the t-test and Pearson’s r was used to analyze the data at (p)>0.05 level of significance.

3.2 Design

The design of the study assessed teaching and learning effectiveness of physics facilities among form two students of Gem District. The researcher used Experimental Design for the study; specifically the study used Pretest Posttest–Control group design, Grinnell, (1993). This is the basis for all the experimental design and suitable for this study. The design involved an experimental and control groups, both created by random sampling and random assignment to the groups Callinger (1973), Shiundu (2004). Figure 3.1 shows the design of the study. Both groups were compared for relationship and difference by gender and age giving results for inference.
Figure 3.1 Pretest-Posttest-Control Groups Design on Students (N=100)

Experimental Group
N=(50)

Pretest O₁ to Measure Independent Variable

Two Weeks Teaching Treatment

Posttest O₂ Re-Measures the Independent Variable

t-test (difference of means, Pearson’s r relationship group

Control Group
N= (50)

Pretest O₁ to Measure Independent Variable

Two Weeks Teaching Without Treatment

Posttest O₂ Re-Measures the Independent Variable

t-Test (difference of means, Pearson’s r relationship group


Figure 3.1 shows randomly sampled respondents as were assigned to the experimental and control groups. The groups responded to questionnaires, took a pretest at the same time, thereafter a treatment was administered only to experimental group then soon after treatment a posttest was administered to both groups. The mean scores were compared and finally data was analyzed using a t-test for significance of difference between means and Pearson’s r coefficient.
for relationships between group performance and facilities by gender, student’s attitudes and age.

The design is written as follows:

<table>
<thead>
<tr>
<th>Group</th>
<th>Pretest</th>
<th>Treatment</th>
<th>Posttest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>R</td>
<td>$O_1$</td>
<td>X</td>
</tr>
<tr>
<td>Control</td>
<td>R</td>
<td>$O_1$</td>
<td></td>
</tr>
</tbody>
</table>

Where:
- $R$ = Random Selection from Population and Random Assignment to Group
- $O_1$ = First Measurement of the Dependent Variable for Pretest
- $X$ = Independent Variable for Treatment
- $O_2$ = Second Measurement of Independent Variable for Posttest

However, for ethical uniformity the control group was later exposed to the treatment after the posttest [$O_2$]. The design used structured questionnaires; interview schedules and observation checklist to collect data from students before and after treatment, additional data relevant on electricity and magnetism which had content questions relevant to the proposed treatment.

Group samples had common characteristic variables. The outputs were compared before and after treatment. The form two students in the sample schools were the subject randomly assigned to groups. The researcher administered pretest to the experimental and control groups. Treatments were administered to students by qualified and trained technicians in secondary schools. Control group did not receive treatments but took pretest and posttest assessment under similar conditions in the schools.
Table 3.1  Assignment of Respondents to Groups (N=100)

<table>
<thead>
<tr>
<th>Experimental N=(50)</th>
<th>Control Group N=(50)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B₁</td>
<td>G₁</td>
</tr>
<tr>
<td>G₂</td>
<td>B₂</td>
</tr>
<tr>
<td>B₃</td>
<td>G₃</td>
</tr>
<tr>
<td>G₄</td>
<td>B₄</td>
</tr>
<tr>
<td>B₅</td>
<td>G₅</td>
</tr>
<tr>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>Bₙ₊₁</td>
<td>Gₙ₊₁</td>
</tr>
</tbody>
</table>


The researcher assigned respondents based on gender balance. The codes B₁-Bₙ (Male) and G₁-Gₙ (Female) were gender representation of student’s name or registration number as assigned to groups beginning with experimental Boy1, then control Girl1 alternating male and female Table 3.2. The study being a comparison between groups, “True” Experiential-Control design is appropriate. The design was able to collect information on students’ performance by administered tests and other independent variables that measured and compared experimental with control scores. The analysis provided statistics for determination of relationship and difference between the group with treatment and that without treatment. The design also provided valid and reliable research results that were valuable. This will serve as additional insight for improving physics education in the country.

3.3 Location of the Study
The location of the study was in Gem District, Nyanza Province, Kenya. The sketch map of the area of study is on Appendix E, shows population of secondary schools and geographical locations of the schools. The schools are categorized as Girls, Boys and Mixed Day Secondary Schools. The schools are located at varied geographical locations with various geographical and communication features. The use of motor vehicles and motorcycles will be appropriate modes of transport to access the schools. The researcher chose the district simply because it was closer to the place of employment and would reduce the research cost.

3.4 Target Population

Population is a complete set of individual subjects in the research study. The assessment study of teaching and learning effectiveness of physics facilities was conducted among form two students of Gem district. The target population consisted of twenty five secondary school; which are also centers for Kenya National Examination Council (KNEC). The survey revealed that there were three boys’ secondary school with four streams each, three girls’ schools with two stream classes. There were nineteen mixed day secondary schools with single stream. Each stream had at least fifty students. A total student population composed of approximately two thousand students and seventy-three physics teachers in the district had equal chance to be involved in the study.
3.5 Sample and Sampling Procedure

The Population considered for the study comprised all form two students of Gem District. The researcher used random sampling to identify schools for the study, from sample schools students were selected by simple random selection and assignment to groups.

- Sample Size

Sample size is the identified sample that was accessible to the researcher to be representative of the entire population. The acceptable sample size estimated from standard error concept was kept within ±3 of sample mean within 95% confidence. Due to limited laboratory space and equipment, fifteen students were admissible per session (standard deviation=15): Sample size was determined from:

\[ e = z \frac{\sigma}{\sqrt{n}} \]; the confidence interval for the universe mean is

Where

\( e \) = acceptable sampling error

\( z \) = the value of the standard variate at a given confidence level from the table; and it is 1.96 for a 95% confidence level;

\( n \) = size of the sample

\( \sigma \) = standard deviation of the population to be estimated by past experience

Hence,

\[ n = 1.96^2 \frac{15^2}{3^2} \]

\[ = 96 \]
Population of form two sample schools was estimated to be 2010 students, from which 210 sample students were randomly selected, further by picking papers 100 students were randomly selected and assigned to groups on equal ratio by gender. This student population was 5% representation of form two students which were approximately one hundred students. The sample size was 210 students drawn as below: the selection was achieved by stratified random sampling technique.

*Table 3.2  Sampling Procedures and Representation*

<table>
<thead>
<tr>
<th>School</th>
<th>Population</th>
<th>Sampling Ratio</th>
<th>Sample Size</th>
<th>% Representation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys</td>
<td>800</td>
<td>10</td>
<td>80</td>
<td>10</td>
</tr>
<tr>
<td>Girls</td>
<td>450</td>
<td>10</td>
<td>45</td>
<td>10</td>
</tr>
<tr>
<td>Mixed Secondary Schools</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boys</td>
<td>290</td>
<td>10</td>
<td>48</td>
<td>10</td>
</tr>
<tr>
<td>Girls</td>
<td>370</td>
<td>10</td>
<td>37</td>
<td>10</td>
</tr>
<tr>
<td>TOTAL</td>
<td>2010</td>
<td></td>
<td>210</td>
<td>10</td>
</tr>
</tbody>
</table>

*Using a constant of K =10 for boys and girls schools.

- **Sampling Technique**

The research was carried out among the sample form two students of Gem district. The study was experimental-control design research study; conducted on a finite population of secondary schools in Gem District. The design used simple random sampling technique for boys and girls secondary schools and stratified sampling for selecting students from mixed secondary schools.
as shown in Table 3.2, the procedure used for sampling data was by survey of the universe in the district, population of schools were recorded and grouped in three mutually exclusive segments or strata of boys, girls and mixed secondary schools as shown in Table 3.3, hence sample students from randomly selected schools became the student samples. Stratified sampling technique produced 50 out 125 boys and 50 girls out 77 girls sampled from a population of 2305 form two students in the district. The representation of was approximately 10% by gender.

*Table 3.3  Distribution of Samples (N=100)

<table>
<thead>
<tr>
<th>Distribution</th>
<th>School’s Category</th>
<th>Population Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Boy’s</td>
<td>Girls</td>
</tr>
<tr>
<td>Schools</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Students in the District</td>
<td>800</td>
<td>450</td>
</tr>
<tr>
<td>Sample Schools</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Sample Students</td>
<td>80</td>
<td>40</td>
</tr>
</tbody>
</table>

*Source: Grinnell Richard JR.1993), Adopted from Table 8.2. Data for Distributional Stratified Sampling for Population of Social Workers and Supervisors Social, Research and Evaluation page 160

The sample size was the sum of students from the strata randomly assigned to groups. Probability sampling without replacement was used on a list of sample secondary then from the sample schools random sampling was used to determine balance representation by gender, where students were sampled by using confidential papers containing fifty “yes” for boys and girls the rest were “No” the study administered the instruments to students who picked “Yes” of equal number by gender.
3.6 Research Instruments

The research instruments used to measure the levels of teaching and learning facilities of physics were:

- Questionnaires
- Observation Checklist
- Interview Schedule

i) Questionnaire consisted of structured, matrix questions and a physics test paper which was developed from a section of the form two syllabus on electricity and magnetism. The researcher collected pretest and posttest scores that were used for rating relationship and difference in performance when teaching and learning was based on physics facilities by:

   a) Gender
   b) School Status
   c) Age
   d) Attitudes

ii) Observation checklist recorded frequency of observed behavior on sample students for rating student’s attitudes and interest toward physics.

iii) Interview schedule was developed: the schedule-structured interview was administered to sample students and teachers. The interviewing was conducted by trained staff who gathered data which conveyed student’s information on performance, enrolment and physics facilities for a period of three years.
3.7 Validity and Reliability of Instruments

- **Validity**

Measuring instrument is valid when it does what it is intended to do (Cronbach, 1970). In the study the measuring instruments measured what they were supposed to measure and yielded scores which reflected the true value of student’s scores, enrolment and attitudes. Validity is largely determined by the presence or absence of systematic errors in the collected data. Content validity was chosen for this study; it concerned with the representativeness or sampling adequacy of the content of the measuring instrument, such as the items or questions it contained. The instrument provided an adequate sample of questions that represented the teaching and learning activities. The concepts were measured and were measured accurately. To satisfy the requirements of content validity all variables being measured were capable of producing operational definitions (Nunnally, 1975, 1978), the data gathered to measure performance, attitudes and enrolment were found to be directly relevant and meaningful to teaching and learning of physics facilities that would be generalized to the entire population of the study.

- **Reliability**

The degree of accuracy, or precision, in measurements an instrument provides what is called reliability. A measuring instrument is reliable to the extent that independent administrations of the same instrument consistently yield similar results. The researcher administered the same questionnaire to the same groups of sample at different times, and computed the reliability coefficient using test-retest technique; a reliability
A reliability coefficient of 0.79 or more would be suitable.

3.8 Data Collection Procedure

After the research problem was defined and research proposal approved by the department, the University Authority issued a letter of introduction to the researcher dated 25th October 2010, National Council of Science and Technology confirmed the authorization by a letter dated 11th November 2010. This was an introduction letter to the Gem District Commissioners and the District Education Officer for a permit to the researcher to visit the schools in the District for data collection. The researcher contacted Principals of selected schools in the district and informed participants, both teachers and students were organized and the teaching and learning process was conducted to students. Students were randomly assigned students to groups and pretest instruments administered. The scores were recorded and forwarded for coding.
The process of teaching and learning continued for a period of at least two to three months, at the same time experimental group was exposed to treatment variables. Soon after treatment, teachers administered posttest to both groups; the scores were recorded and forwarded for analysis.

At the same time the researcher collected completed questionnaire forms sent out to schools and conducted face-to-face interview to teachers and students. Received data were organized and coded for computer analysis. Interviewers and Observers were trained before they used the interview schedules and observation checklist for recording responses from respondents.

3.9 Data Analysis Plan

Assessing effectiveness of teaching and learning of physics facilities among form two students of Gem District in Kenya

Using the mentioned instruments the researcher collected continuous and discrete data from sample groups. Analysis was done using SPSS Package to produce t-tests and Persons Coefficients for inference. The research variables were gender, school status, age, and attitudes. Analysis of data was by hypotheses on data gathered from experimental and control group samples and organized as pretest and posttest mean scores. Analysis produced tables, graphs and figures which provided information on relationships and differences between the variable and teaching and learning of physics using facilities. The study included error possibilities at 0.05 level of significance to reject or retain the null hypothesis. The researcher developed a summary table in Chapter Four. The relevant test statistics t and r were calculated for the sample groups the obtained value compared with probable value based on t-
distribution table. The outputs provided necessary information to access whether there were significant relationships and difference; especially from patterns of graphs, charts, and histograms which were interpreted to determine the attributes of teaching and learning based on facilities for physics in secondary schools.
CHAPTER FOUR: DATA ANALYSIS AND DISCUSSIONS

4.1 Introduction

The study was to assess teaching and learning effectiveness of physics facilities among form two students of Gem District. The study data were collected by interview, observation schedules and questionnaire forms. Records held by schools were also examined for inferences. Analysis for t-statistics, Pearson’s r and Spearman’s correlation coefficient between experimental and control group students’ mean performance in physics was by computer SPSS Package. The formulated hypotheses were tested for inference. Results were interpreted and discussed for recommendations and conclusion. The analysis process and presentation of findings thereof were recorded in this chapter.

4.2 Demographic Analysis

The study was conducted to assess teaching and learning of physics among form two students of Gem District. Data were on personnel, student’s attitudes toward physics, student’s performance in physics by gender and age. Data analysis was based on available physics facilities in sample schools. Physics teachers revealed valuable information on schools personnel, motivation and available apparatus based on teaching and carrying out physics experiments especially measurements on electricity and magnetism. Verbal explanation by teachers was that due to lack of stable Power Supply; Oscilloscope among other equipments demonstration or experiment was not possible. The study also revealed that only one technician was responsible for laboratory preparation of all science experiments in the school. Table 4.1 shows level of resources in a secondary school.
*Table 4.1 Available Resources in Sample Secondary School in Gem District*

<table>
<thead>
<tr>
<th>Physics Resources</th>
<th>Available</th>
<th>Required School Stream</th>
<th>Shortfall</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Human Resource</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physics Teacher</td>
<td>2</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Technician</td>
<td>1</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Laboratory Attendant</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td><strong>Facilities</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laboratory</td>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Major Equipment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oscilloscope</td>
<td>0</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Dc Power Supply</td>
<td>0</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Strong Magnet</td>
<td>5</td>
<td>50</td>
<td>45</td>
</tr>
<tr>
<td><strong>Materials</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Library</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

*Source: Face-to-face Interview from teachers, students and Records held by Schools (November 2010)*

The table shows that schools have inadequate human resources and facilities for effective teaching and learning of physics. To improve teaching and learning of physics schools are required to expand laboratory space, purchase all necessary apparatus and equipment for teaching and learning of physics with experiments. This might create change in students and teachers attitudes toward teaching and learning of physics. Teachers and technicians also required training on the physics apparatus and equipment. However interview revealed that teachers were trained for the purpose of teaching and learning physics but they had deficient skills to handle physics apparatus at all levels without trained technician. The study revealed that schools had libraries but were inadequate to accommodate all reading materials at all levels including physics text books. Schools relied heavily on materials purchased by parents based on the sent out list by respective schools. Presentation on Figure 4.1 shows the levels of
available and required resources for physics in the sample school of Gem District. Further, performance and enrolment were found to be influenced by student’s personal reasons, gender, school status and priorities. Information on Table 4.2 shows the rates at which students disliked continuing with the study of physics in form three. In boy’s schools 11 out of 30 (21%) would drop physics, while in girl’s school 19 out of 30 (36%) of girls disliked the subject and in sample mixed secondary schools 23 out of 30 (43%) students would not choose to continue with the study of physics. Analysis showed that students begin to avoid the study of physics in form two; they gave reasons to drop physics due to insufficient facilities and resources for effective teaching and learning of the subject (teaching method).

*Table 4.2 Student’s Interest to Continue Studying Physics in Form Three (N =90)*

<table>
<thead>
<tr>
<th>School Category</th>
<th>Sample</th>
<th>Against Physics</th>
<th>% -Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys School</td>
<td>30</td>
<td>11</td>
<td>37</td>
</tr>
<tr>
<td>Girls School</td>
<td>30</td>
<td>19</td>
<td>63</td>
</tr>
<tr>
<td>Mixed School</td>
<td>30</td>
<td>23</td>
<td>77</td>
</tr>
<tr>
<td>Total</td>
<td>90</td>
<td>53</td>
<td>59</td>
</tr>
</tbody>
</table>

*Source: Researcher: Interview on Student Interest on the Study of Physics from Schools Sample, July 2010*

The study revealed that students’ overall dropout rate for physics was 53 out of 90 (59%) with the reason that they did not like physics due to lack of proper teaching methods to handle theory and practical physics. In mixed secondary schools student’s dropout rate was influenced by gender as they were complaining about teaching method and nature of the
subject. Female students believed that the subject was difficult that required cramming and calculations. The study also revealed that the number of teachers to handle form two classes was estimated to be (50%) inadequate. The available teachers were found to be inadequate to teach physics at all levels.

*Table 4.3  Demography for Group Samples by Age (N =100)*

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Experimental N</th>
<th>Control N</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>15.5-17.9</td>
<td>35</td>
<td>28</td>
<td>13</td>
</tr>
<tr>
<td>18.0-19.9</td>
<td>14</td>
<td>19</td>
<td>-5</td>
</tr>
<tr>
<td>20.0-22.9</td>
<td>1</td>
<td>3</td>
<td>-2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>50</strong></td>
<td><strong>50</strong></td>
<td><strong>6</strong></td>
</tr>
</tbody>
</table>

*Source: Adapted from computer Stem& Leaf plot based on Research Data Gathered from School between October and November 2010*

Information presented on Table 4.3 shows range of student distribution in the study by age. Analysis revealed that there is no significant difference between the students by age for experimental and control group average ages randomly fall between 17.558 and 18.03 years respectively. The information was obtained by face-to-face interview between the researcher, physics teachers and form two students (school records). The school records provided vital information on student’s enrolment, age and performance for physics since 2005. Information presented on Figure 4.4 shows the proportion of performance and enrolment of physics by school status. Boy’s schools were found to have laboratories with facilities including laboratory technicians. In girls schools the dropout was high due to lack of facilities with attitudes that the
subject is difficult. Survey revealed that girl’s schools had no trained technicians but engaged former physics students as laboratory assistant.

*Table 4.4 Student’s Enrolment and Performance towards Physics

<table>
<thead>
<tr>
<th>Year</th>
<th>Girls Mean Score</th>
<th>Girls Enrolment</th>
<th>Boys Mean Score</th>
<th>Boys Enrolment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>-</td>
<td>-</td>
<td>5.263</td>
<td>7.598</td>
</tr>
<tr>
<td>2006</td>
<td>7.750</td>
<td>8.7</td>
<td>5.78</td>
<td>7.304</td>
</tr>
<tr>
<td>2007</td>
<td>7.500</td>
<td>14.3</td>
<td>5.011</td>
<td>7.012</td>
</tr>
<tr>
<td>2008</td>
<td>6.386</td>
<td>15.2</td>
<td>4.97</td>
<td>8.241</td>
</tr>
<tr>
<td>2009</td>
<td>4.944</td>
<td>27.1</td>
<td>4.12</td>
<td>7.029</td>
</tr>
<tr>
<td>2010</td>
<td>5.526</td>
<td>33.3</td>
<td>3.727</td>
<td>8.19</td>
</tr>
</tbody>
</table>


*Source: DEO’s Office and Schools Record on KCSE Data in Gem District Schools

An examination of information on Table 4.4 revealed that schools which supported teaching and learning of physics by use of facilities for teaching physics have higher enrolment and improved performance in physics. The researcher found that improvement trend was uniform in boys secondary schools since 2005.
Information on Figure 4.1 shows mean enrolment and performance in physics by schools status, there is further indication that boy’s schools recorded highest enrolment and performance in physics. The study noted that students in mixed secondary schools had little information on physics; the schools had no facilities with perception that it is expensive to equip physics laboratory for effective teaching and learning of the subject. The study discussed and found that female students evade physics in form two in favor of biology or chemistry.

4.2.1 Relationship between Students’ Performances in Physics by Gender.

H0: There is no significant relationship between student’s performance in physics when teaching and learning are based on physics facilities by gender.

The summary in the Table 4.5 shows the mean difference between experimental and control group performance by gender.
Table 4.5  Paired Samples Statistics by Gender

<table>
<thead>
<tr>
<th>Paired Sample</th>
<th>Mean</th>
<th>N</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pair 1 Male Experimental Posttest</td>
<td>68.0400</td>
<td>25</td>
<td>15.92556</td>
<td>3.18511</td>
</tr>
<tr>
<td>Female Control Posttest</td>
<td>46.8400</td>
<td>25</td>
<td>12.259962</td>
<td>2.451992</td>
</tr>
<tr>
<td>Pair 2 Female Experimental Posttest</td>
<td>67.8000</td>
<td>25</td>
<td>16.23525</td>
<td>3.24705</td>
</tr>
<tr>
<td>Female Experimental Pretest</td>
<td>40.2400</td>
<td>25</td>
<td>10.33715</td>
<td>2.06743</td>
</tr>
<tr>
<td>Pair 3 Male Experimental Posttest</td>
<td>68.0400</td>
<td>25</td>
<td>15.92556</td>
<td>3.18511</td>
</tr>
<tr>
<td>Pair 4 Female Experimental Posttest</td>
<td>67.8000</td>
<td>25</td>
<td>16.23525</td>
<td>3.24705</td>
</tr>
<tr>
<td>Female Experimental Pretest</td>
<td>40.2400</td>
<td>25</td>
<td>10.33715</td>
<td>2.06743</td>
</tr>
<tr>
<td>Pair 5 Male Experimental Posttest</td>
<td>68.0400</td>
<td>25</td>
<td>15.92556</td>
<td>3.18511</td>
</tr>
<tr>
<td>Male Control Posttest</td>
<td>51.8000</td>
<td>25</td>
<td>16.14001</td>
<td>3.22800</td>
</tr>
</tbody>
</table>

*Source: Data Collected from Schools of Gem District and Analyzed by SPSS Computer Package

Table 4.5 provides statistic on students performance by gender, there is no significant difference between students mean performance among experimental posttest but higher than control posttest and pretest scores due to treatment.

The relationship by Pearson’s correlation between students’ performance in physics by gender was written as:

\[ H_0: \rho = 0; \] (the correlation in the population by gender is zero)

\[ H_a: \rho \neq 0; \] (correlation is different from zero)

The Pearson’s r corresponds to the population correlation denoted by \( \rho \). Information on Table 4.6 represented Pearson’s Correlation coefficients of matched pairs of mean performances between male experimental and female control students by gender. Pearson’s coefficients value for male experimental-female control was determined as \( r=0.117 \) (two-tailed) significant at 0.578 levels for N=50, other correlation values groups were also presented.
### Table 4.6 Analyses of Marched Sample Correlations by Gender

<table>
<thead>
<tr>
<th>Pair</th>
<th>Comparison</th>
<th>N</th>
<th>Correlation</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Male Experimental Posttest &amp; Female Control Posttest</td>
<td>25</td>
<td>.117</td>
<td>.578</td>
</tr>
<tr>
<td>2</td>
<td>Male Experimental Posttest &amp; Female Experimental Posttest</td>
<td>25</td>
<td>.559**</td>
<td>.004</td>
</tr>
<tr>
<td>3</td>
<td>Female Experimental Posttest &amp; Female Control Pretest</td>
<td>25</td>
<td>.404*</td>
<td>.045</td>
</tr>
<tr>
<td>4</td>
<td>Female Experimental Posttest &amp; Male Control Posttest</td>
<td>25</td>
<td>.262</td>
<td>.206</td>
</tr>
<tr>
<td>5</td>
<td>Female Experimental Posttest &amp; Female Control Posttest</td>
<td>25</td>
<td>-.087</td>
<td>.681</td>
</tr>
</tbody>
</table>

**Correlation is significant at the 0.01 level (2-tailed).**
*Correlation is significant at the 0.05 level (2-tailed).*
*Source: Data Organized from Students Performance in Project (2010)*

The Pearson’s Correlation of Male Experimental-Female Control Posttest was 0.117 (two-tailed) sig 0.578 for N=50 was positive indicating weak correlation of student’s performance by gender. As in the case was a two-tailed test we look in the table showing the values for Pearson’s coefficient for N=48 and column ± 0.273 at the 0.05 level of significance. And since the observed value r=0.117 is inside the limits of acceptance regions, we accept the null hypothesis. Therefore in the study correlation of experiential and control by gender r was 0.117. Using a sample of N=50 students by gender, the null hypothesis stated that the correlation in population ((0.117)² =0.014) is not zero, and the research hypothesis is different from zero. Hence, we compared correlation by gender; we would find no case in which performance had no significant difference. From t-test formula: testing the significance of r, when p is zero is given by:
\[ t = r \frac{\sqrt{n-2}}{\sqrt{1-r^2}} \]

\[ = 0.117 \frac{\sqrt{55-2}}{\sqrt{1-0.117^2}} \]

\[ = \frac{0.811}{0.9886} \]

\[ = 0.82226 \]

As Ha is two-sided, we shall apply a two-tailed test for determining the rejection regions at 0.05 levels of significance which come to as under, using table of t-distribution for 48 Degree of freedom

\[ R: \mid t \mid > 2.02 \]

The observed value of \( t \) is 0.82226 which falls in the acceptance region and thus, we accept the \( H_0 \) and conclude that correlation between students mean performance in physics by gender is not statistically significant when teaching and learning is based on physics facilities.

Information on Table 4.6 showed correlations between groups mean performance by gender when teaching and learning are based on physical facilities. Male experimental–female experimental posttest correlation was \( r = 0.559^* \) indicating perfect correlation due to treatment on the group. Where a \( r = -0.087 \) correlation between experimental-control posttest by gender indication of negatively negligible relationship due to facilities.

Research data were further organized to determine frequency tally as shown on Figure 4.2.
The figure presents information on the number of students by gender in experimental and control group with similar scores between 30-100. Information presented on Figure 4.2 was used to estimate correlation of performance between groups of experimental and control posttest group by gender. The researcher correlated difference by frequencies and estimated no of students falling in similar score range. From the histograms, Spearman’s coefficient $r_{sm-F}$ was calculated as given on Table 4.7 below.

*Table 4.7  Correlations of Students Groups by Gender*
## Students

<table>
<thead>
<tr>
<th>Scores</th>
<th>Female Control</th>
<th>Male Experimental</th>
<th>Difference D</th>
<th>D²</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>4</td>
<td>0</td>
<td>-4</td>
<td>16</td>
</tr>
<tr>
<td>35</td>
<td>5</td>
<td>0</td>
<td>-5</td>
<td>25</td>
</tr>
<tr>
<td>40</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>45</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>50</td>
<td>8</td>
<td>0</td>
<td>8</td>
<td>64</td>
</tr>
<tr>
<td>55</td>
<td>5</td>
<td>2</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>60</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>65</td>
<td>2</td>
<td>5</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>70</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>75</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>80</td>
<td>0</td>
<td>4</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>85</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>90</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>95</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

N=12 \[ \sum = 25 \] \[ \sum = 25 \] \[ \Sigma D^2 = 145 \]

*Source: Adapted from Posttest Frequency Data on Histograms Figures 4.2 and 4.3

Calculating rho significant for N=14 at 0.05 levels was based on Spearman’s r:

\[ r_S = 1 - \frac{6 \sum D^2}{N(N^2-1)} \]

Table 4.7 shows the procedure for obtaining the coefficient for experimental–control posttest by gender. The observed frequencies were compared from 30-95, the difference was squared which produced a total

Where:

\[ N \] = No of ranks of students performance

\[ r_{Mexp-Fcon} \] = Spearman’s Correlation Coefficient between Male experimental and Female control with facilities
\[\Sigma D^2 = \text{Sum of the squared difference between ranks.}\]

The null hypothesis was that there is no significant correlation in students’ performance in physics by gender when teaching and learning was based on the facilities. Substituting in equation \(r_{m-f}\):

\[
r_{sm-f} = 1 - \frac{870}{1716}
\]

\[
= 0.49300 \quad \text{df}=12
\]

Where:

\(r_{m-f}\) = coefficient correlation between male experimental and female control by gender.

As in this case was a two-tailed test we look in the table showing the values for Spearman’s correlation in the raw for \(N=12\), and the column for \(r \pm 0.5804\) at \(0.05\) level of significance. And since our calculated \(r=0.4933\) is inside the limits of the acceptance regions, we accept the null hypothesis that there is no correlation in performance in physics by gender when teaching and learning are based on physics facilities.

### 4.2.2 Analysis of Relationship between Student’s Performances in Physics by Age

**H0\(_2\):** There is no significant relationship between students’ performance in physics when teaching and learning is based on physical facilities by age.

Table 4.8 shows t-test of groups where average ages of students in form two experimental and control group were found to be 17.558 and 18.03 years respectively. Student’s performance was recorded and analyzed by age per group. The histogram produced information on Table 4.8. Data gathered were as indicated on Appendix F.

*Table 4.8 Correlation of Sample Performance by Age*
The correlation by age was stated as follows:

Where:

\[ H_0: \rho = 0; \quad \text{(there is no correlation between students performance in physics by age)} \]
\[ H_0: \rho \neq 0; \quad \text{(there is correlation between students performance in physics by age)} \]

Information on Table 4.8 shows correlation of performance in physics between experimental and control posttest by age was \( r = 0.272 \) at 0.058 levels of significance (2-tailed), whereas correlation coefficients of experimental control similar age was 0.029 at 0.937 level of significance (2-tailed) which positive weak correlation.

On testing the significance of \( r \), we considered the null hypothesis, that there is no significant relationship between students performance by age.

*Table 4.9  Paired Samples Correlations Experimental-Control Groups by Age*

<table>
<thead>
<tr>
<th>Students Age and Frequency</th>
<th>N</th>
<th>Correlation</th>
<th>Sig.</th>
</tr>
</thead>
</table>

*Source: Data Gathered by Questionnaire and Records held in Sample Secondary Schools of Gem District.*
<table>
<thead>
<tr>
<th>Pair</th>
<th>Description</th>
<th>N</th>
<th>Correlation Coefficient</th>
<th>Significance Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pair 1</td>
<td>Mid age of Students &amp; Experimental Frequency</td>
<td>10</td>
<td>-0.459</td>
<td>0.182</td>
</tr>
<tr>
<td>Pair 2</td>
<td>Mid age of Students &amp; Control Frequency</td>
<td>10</td>
<td>0.029</td>
<td>0.937</td>
</tr>
<tr>
<td>Pair 3</td>
<td>Experimental Frequency &amp; Control Frequency</td>
<td>10</td>
<td>0.339</td>
<td>0.337</td>
</tr>
</tbody>
</table>

*Source: Adopted from t-statistic data gathered by questionnaire among form two students of Gem District (2010)*

As in the case was a two-tailed test we look in the table showing values for Pearson’s coefficient for N=10, we found r required for rejecting the hypothesis as r=±0.632. And since the observed value of r = 0.339 and -0.459 are inside the limits of the acceptance region, we accept the null hypothesis. Hence analysis set the probability limit so that the correlation was correct 95 times out of 100 (0.05) level., when ρ is assumed to be zero , under the null hypothesis, the statistical significance was done by converting r to a standard score using the t test statistic with (n-2) 8 degrees of freedom. Thus t is defined as follows:

\[
t = \frac{r \sqrt{(n-2)}}{\sqrt{1-r^2}}
\]

\[= (0.339) \frac{\sqrt{8}}{\sqrt{1-(0.339)^2}} \]

\[= 1.0192583 \text{ (df 48);} \]

As Ha2 is two sided, we shall apply a two-tailed test for determining the acceptance regions at 0.05 level of significance which comes as under, using table of t- distribution for 8 degree of freedom;

\[R: |t| = 2.306\]
As the obtained value of t is 1.0192 is smaller than the value, and falls in the acceptance region and thus, we retained the null hypothesis at 0.05 levels and conclude that relationship between student’s performance in experimental and control group by age is not significant.

4.2.3 Correlation of Student’s Performance in Physics by Attitudes

H03: There is no significant relationship between student’s performance in physics when teaching and learning are based on facilities by attitudes towards teaching with facilities.

Data collected among experimental and control posttest sample groups were expected to demine whether students would continue with the study of physics when teaching and learning are based on facilities. The hypothesis can be written as:

H03: \( \rho_3 = 0 \); (The is no correlation between students performance by attitudes)

H0a3: \( \rho_3 \neq 0 \); (there is correlation between students performance by attitudes)

Gathered data were analyzed by computer SPSS Package. Results are presented on Table 4.10

*Table 4.10 Difference between Experimental and Control Group on Measures of Students Attitudes toward Physics.

<table>
<thead>
<tr>
<th>Paired Sample</th>
<th>Mean</th>
<th>N</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pair 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fully Agree</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental</td>
<td>1.4375</td>
<td>16</td>
<td>1.50416</td>
<td>.37604</td>
</tr>
<tr>
<td>Fully Agree</td>
<td>.5625</td>
<td>16</td>
<td>.81394</td>
<td>.20349</td>
</tr>
<tr>
<td>Control</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pair 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agree</td>
<td>15.875</td>
<td>16</td>
<td>17.43894</td>
<td>4.35974</td>
</tr>
<tr>
<td>Experimental</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agree Control</td>
<td>11.4375</td>
<td>16</td>
<td>15.71398</td>
<td>3.92849</td>
</tr>
<tr>
<td>Pair 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neutral</td>
<td>2.9375</td>
<td>16</td>
<td>7.37987</td>
<td>1.84497</td>
</tr>
<tr>
<td>Experimental</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neutral Control</td>
<td>5.625</td>
<td>16</td>
<td>13.04799</td>
<td>3.26200</td>
</tr>
<tr>
<td>Pair 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disagree</td>
<td>23.5625</td>
<td>16</td>
<td>17.91077</td>
<td>4.47769</td>
</tr>
<tr>
<td>Experimental</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disagree Control</td>
<td>7.6875</td>
<td>16</td>
<td>12.94974</td>
<td>3.23744</td>
</tr>
<tr>
<td>Pair 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fully Disagree</td>
<td>1.9375</td>
<td>16</td>
<td>2.43499</td>
<td>.60875</td>
</tr>
<tr>
<td>Experimental</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fully Disagree</td>
<td>16.750</td>
<td>16</td>
<td>15.58846</td>
<td>3.89711</td>
</tr>
</tbody>
</table>

*Sources: Research Questionnaires to Students on the Physics (2010)
The table provides t-test between student’s attitudes toward teaching and learning of physics when teaching and learning are based on facilities.

Table 4.11 provides Person’s correlation between student’s attitudes towards performance and retaliation in the study of physics.

*Table 4.11  Paired Samples Correlations by Attitudes

<table>
<thead>
<tr>
<th>Students Response by Attitudes</th>
<th>N</th>
<th>Correlation</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pair 1  Fully Agree Experimental &amp; Fully Agree Control</td>
<td>16</td>
<td>.493</td>
<td>.052</td>
</tr>
<tr>
<td>Pair 2  Agree Experimental &amp; Agree Control</td>
<td>16</td>
<td>.750</td>
<td>.001</td>
</tr>
<tr>
<td>Pair 3  Neutral Experimental &amp; Neutral Control</td>
<td>16</td>
<td>-.179</td>
<td>.507</td>
</tr>
<tr>
<td>Pair 4  Disagree Experimental &amp; Disagree Control</td>
<td>16</td>
<td>.019</td>
<td>.944</td>
</tr>
<tr>
<td>Pair 5  Fully Disagree Experimental &amp; Fully Disagree Control</td>
<td>16</td>
<td>.033</td>
<td>.904</td>
</tr>
</tbody>
</table>

*Source: Computer output from Data Gathered on Students Attitude toward Physics Performance and Teaching Facilities

As in the case was a two tailed test we look in the table showing the values for Pearson’s r and the observed coefficients for N= 14 as the value of r= 0.468 at 0.05 level of significance, is required for rejecting the null hypothesis. And since the observed value r= 0.750 for N=14 was greater that the value and is outside the limits of acceptance region, we reject the null hypothesis.

The observed correlation of student’s response between male experimental and female control posttest on attitudes was r=0.750 at 0.001 level of significance with 14 degree of freedom. Using t–test to establish the significance of correlation .When ρ is assumed to be zero under the null hypothesis, converting r to a standard score using t-test with df=14. Thus t is defined as follows:

Where 
\[ t = r \frac{\sqrt{n-2}}{\sqrt{1-r^2}} \]

69
As \( H_a \) is two-sided, we apply a two-tailed test for determining the rejection region at 0.05 levels which come to as under, using table of t-distribution for 14 degree of freedom

\[
R: |t| > 2.14
\]

The observed value of \( t \) is 6.1812 which is in the rejection region and thus, we reject \( H_0 \) and conclude that students attitudes towards physics performance is statistically significant.

4.2.4 Analysis of Difference between Students Mean Performance by gender

\( H_0 \): There is no significant difference between students performance in physics when teaching and learning of physics are based on physics by gender.

The analysis of data gathered for determination of the difference between students mean performance in physics by gender was as follows.

Taking the null hypothesis written as:

Null; \( H_0 \): Mean\(_{male\ posttest} \neq \) Mean\(_{female\ control} \) (No difference in performance by gender)

\( H_a \): Mean\(_{male\ posttest} \neq \) Mean\(_{female\ control} \) (There is difference in performance in physics when teaching and learning are based on facilities by gender)

Table 4.12 provides t-test difference between students mean performance by gender was as indicated for N=25:
Table 4.12  Paired-Samples Statistic t-Test by Gender

<table>
<thead>
<tr>
<th>Pair</th>
<th>Experimental Gender</th>
<th>Posttest Mean</th>
<th>N</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Male</td>
<td>68.0400</td>
<td>25</td>
<td>15.92556</td>
<td>3.18511</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>46.8400</td>
<td>25</td>
<td>12.259962</td>
<td>2.451992</td>
</tr>
<tr>
<td>2</td>
<td>Female</td>
<td>67.8000</td>
<td>25</td>
<td>16.23525</td>
<td>3.24705</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>51.8000</td>
<td>25</td>
<td>16.14001</td>
<td>3.22800</td>
</tr>
<tr>
<td>3</td>
<td>Male</td>
<td>68.0400</td>
<td>25</td>
<td>15.92556</td>
<td>3.18511</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>67.8000</td>
<td>25</td>
<td>16.23525</td>
<td>3.24705</td>
</tr>
<tr>
<td>4</td>
<td>Male</td>
<td>68.0400</td>
<td>25</td>
<td>15.92556</td>
<td>3.18511</td>
</tr>
</tbody>
</table>

*Source: Data Gathered from Pretest-Posttest by Questionnaire among form two students of Gem District (2010)

Using the t-test to establish the significance of the difference between experimental and control posttest performance by gender was by:

\[
t = \frac{\text{Mean of experimental} - \text{Mean of Control}}{\text{SedM}}
\]

Where:

SedM : is the standard error of the difference between the means given by gender as:

\[
\text{SedM} = \sqrt{(\text{std error of Experimental})^2 + (\text{std error of control})^2} = \sqrt{(3.185^2 + 2.452^2)} = 4.02
\]

The difference between mean performances of experimental–control posttest was 68.04-46.84=21.2. Hence:

\[
t = \frac{21.20}{4.02} = 5.274
\]
As $H_{a4}$ is two-sided, we shall apply a two-tailed test for determining the rejection region at 0.05 level of significance which come to as under, using table of $t$-distribution for 48 degree of freedom:

$$ R: \left| t \right| > 2.02 $$

The observed value of $t$ is 5.274 which fall in the rejection region and thus, we reject $H_{04}$ and concluded that the difference between mean performances of group is significant.

Further $t$-tests statistics by computer were presented on Table 4.13, where a value of $t$ for male experimental-female control posttest is 5.600.

*Table 4.13  Paired Samples $t$-Test of Students Attitudes on Physics by Gender*

<table>
<thead>
<tr>
<th>Paired Samples</th>
<th>Paired Differences</th>
<th>95% Confidence Interval of the Difference</th>
<th>T</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean Difference</td>
<td>Std. Deviation</td>
<td>Std. Error Mean</td>
<td>Lower</td>
<td>Upper</td>
</tr>
<tr>
<td>Pair 3</td>
<td>Male Experimental Posttest - Female Experimental Posttest</td>
<td>.2400</td>
<td>15.105</td>
<td>3.0212</td>
<td>-5.995</td>
</tr>
</tbody>
</table>

*Source: Data collected by questionnaires in sample schools of Gem District.

Information in Table 4.13 shows statistics for paired difference in performance between sample groups by gender. For instance; male experimental-female control posttest was such that the observed $t=5.600$ df 48 compared with the calculated value of $t$ is 5.2733, level of significance of
0.000 with two-tailed test, both values of t are greater than the value needed for rejection 
(t=2.02) at the 0.05 level of significance. We reject the null hypothesis and concluded that the 
difference between students performance in physics by gender when teaching and learning are 
based on physics facilities is due to treatment.

4.2.5 Analysis of Difference between Students Mean Performance by age

H05: There is no significant difference between students performance in physics when teaching 
and learning are based on facilities by students age.

*Table 4.14 Posttest Paired Samples Test Statistics by Age  (N=50)*

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>N</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pair 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental by Age</td>
<td>17.5580</td>
<td>50</td>
<td>1.08517</td>
<td>.15347</td>
</tr>
<tr>
<td>Control by Age</td>
<td>18.0340</td>
<td>50</td>
<td>1.04990</td>
<td>.14848</td>
</tr>
<tr>
<td>Pair 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental Posttest</td>
<td>68.3000</td>
<td>50</td>
<td>16.02581</td>
<td>2.26639</td>
</tr>
<tr>
<td>Control Posttest</td>
<td>62.7600</td>
<td>50</td>
<td>13.68085</td>
<td>1.93476</td>
</tr>
</tbody>
</table>

*Source:* Adapted from Stem Leaf Data Collected by Questionnaires in Sample Schools of Gem District. Research 
statistics from sample schools September to December 2010. Data gathered by questionnaire.

The study found that student’s average ages for experimental and control fall between 17.558 and 
18.034 years respectively, Table 4.14 shows the statistics of student’s ages and frequencies 
of students of the similar age bracket .(Ref demography section)

Using information on table 4.12, the t-statistic was determined between mean experimental and 
control by age as follows:

\[
t = \frac{\text{Mean of Experimental} - \text{Mean of Control}}{\text{SedM}}
\]

Where,
SedM is the standard error or the difference between the means given by gender as:

\[
\text{SedM} = \sqrt{((\text{std error of Experimental})^2 + (\text{std error of control})^2) = \sqrt{(2.22961)^2 + 1.944263^2)} = 2.95826
\]

The difference between mean performances of was 5.80. The value of t is given as:

\[
\frac{5.80}{2.95826} = 1.9601 \quad \text{degree of freedom} = 98
\]

As \(H_a\) is two-sided, we shall apply a two-tailed test for determining the rejection region at 0.05 levels which come to as under, using table of t-distribution for 98 degree of freedom:

\[
R: |t| > 1.990
\]

The observed value of t is 1.9601 which is in the acceptance region and thus, we accept \(H_0\) and conclude that the difference between students performance by age is insignificant.

*Table 4.15 Paired Samples Test for Experimental-Control groups*

<table>
<thead>
<tr>
<th>Pair 1</th>
<th>Experimental by Age - Control by Age</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
<th>95% Confidence Interval of the Difference</th>
<th>T</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>-.4760</td>
<td>1.29229</td>
<td>.18276</td>
<td>-.8433</td>
<td>-.1087</td>
<td>-2.605</td>
<td>49</td>
</tr>
<tr>
<td>Pair 2</td>
<td>Experimental Posttest - Control Posttest</td>
<td>5.5400</td>
<td>22.2455</td>
<td>3.1460</td>
<td>-.7821</td>
<td>11.8621</td>
<td>1.761</td>
<td>49</td>
</tr>
</tbody>
</table>

*Source: Adopted from Research data on Students Performance by Age Analyzed in Table 4.14*

From summary statistic on Table 4.15 the result reveals that t statistic for experimental – control posttest by age was 1.761 at 0.084 level of significance. When applying a two-tailed
test for determining the rejection region at 0.05 levels which come to as under, using table of t-distribution for 48 degree of freedom.

\[ R: \mid t \mid > 2.145 \]

As observed value of t is 1.761 which fall in the acceptance region and thus we accept H0 and conclude that the difference between students mean performance by gender is insignificant.

### 4.2.6 Analysis of Students Performance in Physics by Attitudes

**H0**: There is no significant difference between students’ interest in the study of physics by gender when teaching and learning are based on physical facilities by attitudes.

Taking the null hypothesis that student’s attitude toward physics has no influence in performance in physics can be written as:

- **H0**: \( \mu_{\text{Male}} = \mu_{\text{Female}} \); (there no between students attitudes towards the study of physics),
- **Ha**: \( \mu_{\text{Male}} \neq \mu_{\text{Female}} \); (there is difference between attitudes towards the study of physics)

From the study response data between the groups produced t-statistic on paired sample, the value between experimental male and control female samples t was 1.8688 (two-tailed) with 14 degree of freedom at 0.079 levels.
*Table 4.16  Paired Samples t-test on Students Attitudes toward Physics

<table>
<thead>
<tr>
<th>Students Resonance on the Variables</th>
<th>Paired Differences</th>
<th>95% Confidence Interval of the Difference</th>
<th>t</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Std. Deviation</td>
<td>Std. Error Mean</td>
<td>Lower</td>
<td>Upper</td>
</tr>
<tr>
<td>Pair 1 Fully Agree Experimental - Fully Agree Control</td>
<td>.8750</td>
<td>1.31022</td>
<td>.32755</td>
<td>.1768</td>
<td>1.5732</td>
</tr>
<tr>
<td>Pair 4 Disagree Experimental - Disagree Control</td>
<td>15.875</td>
<td>21.89939</td>
<td>5.4748</td>
<td>4.2056</td>
<td>27.5444</td>
</tr>
</tbody>
</table>

*Source: Adopted from Table 4.8 on Research Statistics from Students Response on Attitude toward Physics. Data Gathered by Questionnaire. September to December 2010

Table 4.16 shows the statistics for students attitudes toward teaching and learning physics with facilities giving a value of t for experimental male-control female was 2.671 significant at 0.017 level with 14 degree of freedom. As Ha₆ is a two-side, we shall apply a two-tailed test for determining the rejection region at 0.05 levels which comes to as under, using table of t-distribution for 14 degree of freedom:

\[ |t| > 2.146 \]

The observed value of t is 2.671 which fall in the rejection region and thus, we reject H₀₆ and conclude that there is significant difference in student’s attitudes toward physics between the groups by gender at 0.05 levels of significance.
4.3 Discussion of Findings

The purpose of study was to assess the teaching and learning effectiveness of physics facilities among form two students of Gem District. The study was based on experimental control design for difference and relationship between the groups by gender, student’s attitudes, students’ age and school status. Data was analyzed by computer SPSS Package for inferential using the t-test, Spearman’s r and Pearson’s r coefficients for relationship between experimental and control groups.

Pearson’s coefficient for relationship between male experimental–female control posttest was \( r = 0.117 \) significant at 0.578. Testing the significance by t-statistic was 0.82226 at 0.05 level of significance. \( H_0 \) was accepted confirming that there is no correlation between the groups mean performance in physics by gender when teaching and learning was base on theory and experiment. The study revealed that learning of physics is not influenced by student’s ages and attitudes when teaching and learning are based on physics facilities. On student performance by age, the \( r \) obtained was 0.272 which fall in the acceptance regions the produced \( t \) was less than 1.990 for 98 degree of freedom at 0.05 levels of significance, which was not statistically significant for rejecting the null hypothesis. There was no correlation between students performance in physics by age when teaching and learning are based on physics facilities.

Further analysis on \( H_0 \), established that correlation of students attitudes towards physics between experimental and control group was \( r = 0.750 \) for \( N = 14 \).analysis at 0.001 level of significance revealed that correlation was statistically significant. The t-test determined that student’s attitudes towards teaching and learning of physics is significant, \( t = 6.182 \) at 0.05 level of significance with 48 degree of freedom. Whereas from \( H_0 \) provides analysis of difference
between experimental and control group by age and attitudes toward performance in physics when teaching and learning are based on physics facilities was significant \( t=1.9601 \) with degree of freedom 98 at 0.05 level of significance. Analysis of student’s attitudes towards physics when teaching and learning are based on physics facilities by age with significance at 0.05 levels was insignificant. Correlation of performance and facilities by that change of attitudes was noted to have begun since 2006 after SMASSE launched a training program for science teachers in the District. According to records held by secondary schools of Gem District, the program had positive effects on enrolment, performance, laboratory facilities and popularity of the subject. The H0 was rejected; that there is relationship between students attitudes with performance in physics so long as teaching and learning are based on facilities. The value of Pearson’s’ correlation \( r \) of 0.750 between experimental male-control female posttest on attitudes towards physics performance \( N=16 \) (df= 14); while the t-test of 2.671 at 0.05 level of significance was higher and in the rejection region. The null hypothesis was rejected, the value cannot be accepted, the relationship between student attitudes by gender and physics performance is said to be significant.
CHAPTER FIVE: DISCUSSIONS AND CONCLUSION

5.1 Introduction

The study was to assess teaching and learning effectiveness of physics facilities among form two students in Gem District. The study was undertaken the public secondary schools between August 2010 and February 2011 by qualified personnel. The gathered data were analyzed by computer SPSS package which produced t-statistics and correlation coefficient between the groups. The study design was pretest–posttest control design. Analysis produced posttest and pretest mean statistics and Pearson’s r for difference between means and relationship with the variables. The produced statistics was further analyzed for t-tests and rho for statistical inference.

5.2 Summary of Findings

The study was undertaken under the conditions stated in chapter three and the findings were based on the formulated hypotheses which produced the following results summarized in Table 5.1. The level of significance are set 0.05 or 0.01 which means that null hypothesis is to be rejected if the sample outcome is among the results that would have occurred by chance no more than 5 percent or 1 per cent of the time.

H0: There is no significant relationship between student’s performance in physics when teaching and learning are based on physics facilities by gender.

From the summary Table 4.4 and 4.5 shows students’ mean difference produced Pearson’s Correlation between male experimental–female control posttest performance was determined to be $r=0.117$ at 0.578 level significance $df=48$ (SPSS analysis). The calculated spearman’s coefficient was $r=0.493$ at 0.05 level of significance $df=14$. Both coefficients fall inside the
limits of the acceptance region, we accept the null hypothesis, thus there is correlation between students performance in physics by gender when teaching and learning are based on physics facilities. Hence, analysis set the probability limit so that the correlation was correct 95 times out of 100 (0.005) level concerning the true correlation, we add 2(0.143) standard error to 0.117 for upper limit, and subtract 2 (0.143) standard error to 0.117 for lower limit. The range within which the true $r$ falls was found as between 0.168 and 0.403 (Degree of Freedom, N=48) significant at 0.05 levels. The correlation falls within the acceptance region; hence we accept the null hypothesis and conclude that there is no correlation student’s performance in physics by gender. The result was confirmed by Spearman’s $r$ correlation, that there is no significant relationship between students performance by gender when teaching and learning was based on physics facilities.

**H0$_2$:** There is no significant relationship between student’s performance in physics when teaching and learning is based on physical facilities by age.

The test has indicated that H0$_2$ is true: There was no significant relationship between student’s performance by age when teaching and learning is based on physics facilities. The correlation for students performance by age with facilities was $r=.272$ significant at .05 level. The statistical significance merely indicates the probable influence of chance or sampling error on students by gender. Hence, there was no significant relationship of performance between experimental and control samples by age due to treatment conducted to the experimental group. The control group performance was good due side effects. We concluded that effectiveness in teaching and learning physics could be improved by facilities regardless of age. Hence due to use of facilities for
teaching and learning physics there was no relationship between facilities and performance by age.

**H0**: There is no significant relationship between student’s interest in the study of physics when teaching and learning are based on physics facilities by attitudes.

As in the case was a two tailed test we look in the table showing the values for Pearson’s coefficients for N= 16 and the value of r= 0.468 at 0.05 level, is required for rejecting the null hypothesis. And since the observed value r= 0.891 is outside the limits of acceptance region, we reject the null hypothesis.

The observed correlation of student’s response between male experimental and female control posttest on attitudes was 0.8910 with 16 degree of freedom. T-test was 7.3432 at 0.05. The observed value of t is 7.3432 which is in the rejection region and thus, we reject H0 and conclude that student’s attitudes towards physics performance is statistically significant.

According to Deputy Principle Joram Opiyo (Sawagongo High School, 2011) enrolment and performance improved since 2005 to date after the school refurbished physics laboratory in 2003. The study noted that students in mixed secondary schools had little information on physics, the schools had no facilities but student had perception the physics is hard. The study discovered that female students evade physics in favor of Biology or Chemistry. Research data indicated that 87.7 per cent teachers were trained but lack teaching facilities for physics. According to Mildred Oketch, The Deputy Principal Nyagondo Mixed Secondary School (2010), girls drop physics in form two hence, KCSE enrolment for physics was 40 percent with mean score of 5.35.
**H0₄:** There is no significant difference between student’s mean performance in physics when teaching and learning is based on physic facilities by gender.

The investigator examined information in Table 4.11 and found that students mean performance was different when teaching and learning are based on physics facilities by gender. This finding supports the knowledge claim by Chitwa and Njoge (2004), SMASSE (2006) that teaching and learning based on facilities improves student’s means performance in physics. Further examination of the table revealed that there is no significant a between mean of students performance in experimental group by gender. Accordingly, we reject H₀₄ and conclude that the difference between student means reflects the effects of treatment not by gender. Analysis of performance and relationships between schools by status revealed that boy’s schools supported teaching and learning of physics since introduction SMASSE training program enrolment and performance was found to be high in boy’s schools than others. It was found that effects of treatment were positive among the boy’s schools concluding that treatment was effective by school status.

**H0₅:** There is no significant difference in performance between teaching and learning of physics by student’s age.

Analysis comparing students mean performance in physics by age reveled that there is no significant difference between experimental and control groups. Data in the summary Table 4.12, describes the mean performance of students by mean age. We observed that the value of t is within the acceptance region. This revealed that student’s performance in physics is not influenced by age. The finding supports KIE, Objectives Report Series No. 53 p.45 that students
should be well prepared for all aspects of 8-4-4 system. The result has shown that student’s performance in physics improves with facilities regardless of age. Accordingly, we accept H0₅ and conclude that the difference in student’s group mean performance reflects no difference in student’s performance in physics by age.

**H0₆:** There is no significant difference in student’s interest in physics when teaching and learning is based on facilities by attitudes toward physics.

The researcher examined the results of that data analysis on table 4.13 and concluded from the statistical results shown that student’s attitude toward physics is supported by teaching methods. The finding supported the knowledge claim by Khan and Weiss (1973) that students and teachers should change their attitude toward the subject. We observed that the value of t is greater than that value needed for rejection (2.131) at 0.05 level of significance. In other words; the difference in attitudes between the groups is due to treatment. According to Crawley and Black (1992) they found that student’s enrolment for a study was determined by their attitudes towards the subject. Accordingly, we reject H0₆ and conclude the difference between groups by attitudes is significant toward physics. The study further revealed that inclusion of more information on physics application motivated students and staff. Analysis revealed that enhancement and development of student interest towards physics required teaching and learning by theory and experiment. The teaching method had positive effects on student’s attitudes toward the subject which would result in improved performance that would eventually motivate students for sustenance in the study of physics.
## Table 5.1 Summary of Inference

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Paired Samples</th>
<th>Pearson’s r</th>
<th>Spearman’s r</th>
<th>t</th>
<th>Reject/Accept</th>
<th>Comments on Null Hypothesis</th>
<th>Comments on Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>H0</strong>, p=0; Correlation between students performance by gender</td>
<td>Experimental–Control Posttest by age</td>
<td>0.117</td>
<td></td>
<td>0.8226</td>
<td>ACCEPTED</td>
<td>There is no significant correlation between performance by gender</td>
<td>No correlation between students performance by gender</td>
</tr>
<tr>
<td><strong>H0</strong>, p=0; Correlation between performance by age</td>
<td>Experimental–Control Posttest by age</td>
<td>0.0272</td>
<td></td>
<td>1.9585</td>
<td>ACCEPTED</td>
<td>There is no correlation in students performance by Age</td>
<td>No correlation in students performance by Age</td>
</tr>
<tr>
<td><strong>H0</strong>, p=0; Correlation between Students Performance by Attitudes</td>
<td>Experimental–Control for Physics Posttest</td>
<td>0.750</td>
<td></td>
<td>6.343</td>
<td>REJECTED</td>
<td>There is students correlation between Students performance in physics by Attitudes</td>
<td>Significant correlation between students Attitudes toward and Performance</td>
</tr>
<tr>
<td><strong>H0</strong>, Difference between means by gender</td>
<td>Mean of Experimental Male-Control Female Posttest</td>
<td>0.262</td>
<td></td>
<td>4.068</td>
<td>REJECTED</td>
<td>Treatment was effective. Difference significant with facilities</td>
<td></td>
</tr>
<tr>
<td><strong>H0</strong>, Mean Difference between experimental – Control posttest by age</td>
<td>Difference between Experimental – control by age</td>
<td></td>
<td></td>
<td>1.960</td>
<td>ACCEPTED</td>
<td>There is no difference in performance by students age</td>
<td></td>
</tr>
<tr>
<td><strong>H0</strong>, Performance in Physics by Attitudes</td>
<td>Fully Against Experimental-Control group</td>
<td>Df=16</td>
<td>r=0.493</td>
<td>2.671</td>
<td>REJECTED</td>
<td>There is significant difference between student’s attitudes towards physics</td>
<td></td>
</tr>
</tbody>
</table>

*Source: Adapted from Hypotheses Results for Research in Secondary Schools of Gem District*
5.3 Conclusion

The study revealed that teaching and learning of physics could be enhanced by theory and experiments. In the study treatment improved student’s performance, interest and could enhance student’s enrolment in secondary schools. Concerning technical staff there was indication that schools do not employ competent technicians but are employed by the school Board of Governors resulting into their mobility for better terms of service. The study found that due to lack of facilities and technical personnel negatively affected teaching and learning of physics in secondary schools.

The study determine that students decided to drop out from the study of physics in form two, but schools supporting physics had high enrolment rate. Hence, more boys enroll for physics than girls but there was no difference in performance by gender when teaching and learning was based on physics facilities. According to Sawagongo Boys Secondary School (2010) enrolment had improved since 2005 due to refurbishment of physics laboratory in 2003. The researcher concluded that enrolment rate and performance was high in schools which emphasized on importance of facilities for teaching and learning of physics. According to the research inferential statistics on student’s performance and relationships showed that there is no difference in performance by gender when teaching and learning was based on physics facilities. Finally, physics is an experimental subject; the study revealed that by using physics facilities for teaching and learning motivated both the teachers and students to develop interest in the subject.
5.4 Recommendations

Physics still remains an important subject as a requirement for the development of science and technology; hence schools should put emphasis on the development of state of the art physics laboratories in support of the changes in teaching methods for physics. The study revealed availed human resources and facilities for physics improved teaching and learning among students in secondary schools. It was noted that attitudes toward physics significantly influenced by treatment. Therefore the following recommendations were made:

1. School should put emphasis on teaching and learning physics with facilities

2. Administration to ensure that schools have relevant human resources and physics facilities for teaching and learning on physics.

3. Physics is an experimental science; Ministry of Education should encourage development of state of the art physics laboratories with facilities for each secondary school.

4. School should employ trained technical staff for teaching in the laboratory for physics more they should be employed by TSC.

5. Students be encouraged to do laboratory experiments freely as part of the study to justify the often quote “Hear and forget, see and remember, do and understand” as is widely accepted to be ideal in early stages of learning physics.

6. University and College to reorganize physics training program with emphasis on both academic and practical skills that should enable leaves to handle secondary school physics at all levels.

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5.5 Recommendation for Further Research

The limitations of the study were time and finance available for research. There was need for recruitment and retraining of research participants, however the researcher decided to determine the need to enhance teaching and learning of physics by facilities in form two. From the findings we concluded that there is need to continue with the research at all levels in secondary schools to determine effectiveness of the teaching method. The study would require finance of Sh. 18,631,000/= and the time period between 3 and 5 years the table below provides an estimate for the study.

*Table 5.2 Estimates for Further Research

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<th>Personnel</th>
<th>Rate</th>
<th>Materials</th>
<th>Total</th>
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</thead>
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<td>25,000.00</td>
<td>27,600.00</td>
</tr>
<tr>
<td>Technician</td>
<td>2,600.00</td>
<td>25,000.00</td>
<td>27,600.00</td>
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<tr>
<td>Interviewer</td>
<td>2,600.00</td>
<td>10,000.00</td>
<td>12,600.00</td>
</tr>
<tr>
<td>Observer</td>
<td>2,6000.00</td>
<td>10,000.00</td>
<td>12,000.00</td>
</tr>
<tr>
<td>Facilitators</td>
<td>3,600.00</td>
<td>50,000.00</td>
<td>53,600.00</td>
</tr>
<tr>
<td>Overheads</td>
<td>50,000.00</td>
<td>40,000.00</td>
<td>45,000.00</td>
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<tr>
<td>Service Staff</td>
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<td>Nil</td>
<td>2,300.00</td>
</tr>
<tr>
<td>Total</td>
<td>21,800.00</td>
<td>160,000.00</td>
<td>189,300.00</td>
</tr>
</tbody>
</table>

*source: Estimated Derived from Research Activities

The research would involve all activities for teaching and learning physics and organizing seminars for teachers and technicians before the commencement of the research study. However,
due to lack of time and financial support the study was restricted to gather information which could have been inadequate to provide broad insight on the problem faced by teaching and learning of physics. The process required expertise and finance to support the research participants, training of teachers and technicians on the use of physics facilities. Despite the difficulties encountered, schools availed stored information and facilities which we used in the study for the summary and recommendations.
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Orodho J.A Kombo J., University, Pac/SMD/104 *Research Methods*, Bureau of Educational Research, Kenyatta University, Nairobi

Ouko C. (2004 August)“SMASSE; *Initiative to Improve Mathematics and Science*” Teaching Image Vol. 9 p. 23


Walter, R Borg and Meredith D Gall (1999), An Introduction Educational Research, Fifth Edition, USA
Appendix A
Letter of Introduction

From: John Otiato-E55/OL/15846/2005  Jan 2011
To: Respondent

Dear Sir/Madam,

The attached survey instrument concerned with the investigation into the factors which inhibit success in teaching and learning of physics in secondary schools part of the educational study for a master’s degree at Kenyatta University. This research was concerned specifically with determining the present problems of teaching and learning the subject in schools of Gem district. The result of this study will help to provide criteria to be followed for developing the subject’s in teaching and learning administrative process.

We are particularly desirous of obtaining your responses because your experience in educational administration and teaching will contribute significantly towards solving some of the problems faced in this important area of education. The enclosed instrument has been tested with a sampling of the subject teachers and school administrators, and we have revised it in order to make it possible for us to obtain all necessary data while requiring a minimum of your time. The average time required for administrators trying out the survey instrument was 10.5 minutes.

We will appreciate it if you will complete the form before Feb 10th 2011 and return it to the researcher. Other phases of this research cannot be carried out until we complete the analysis of the survey data. We would welcome any comments that you may have concerning any aspect of teaching and learning of physics not covered in the instrument.

Your response will be held in strict confidence, and we will be pleased to send you a summary of the survey results if you desire. Thank you for your cooperation.

Yours Sincerely

John Otiato
(2010 November)
APPENDIX B
Questionnaire

Part 1.
Section 1

Section to be filled by students
In this section of our survey we would like to develop a sort of sketch of student’s interest towards physics.
Please Circle the number, which represents appropriately where you belong and complete the spaces for question 7.

Question 1 Which category of secondary school are you attached?
1 Boys 2 Girls 3 Mixed 4 Others

Question 2 Do you like science?
1 Yes 2 No 3 Others

Question 3 Do you like physics?
1 Yes 2 No 3 Other

Question 4 What is your view on the subject?
1 It is difficult 2 It is not important 3 It is like others 4 Other

Question 5 When did you know about physics as a subject?
1 Primary 2 Form 1 3 Form 2 4 Others

Question 6 What is your future career development plan?
1 Engineer 2 Lawyer 3 Administration 4 Other

Question 7 Are you interested to continue with Physics up to KCSE combinations?
1 Yes 2 No 3 Others

Section 1
In this section of our survey we would like to develop a sort of sketch of Students performance when teaching and learning incorporate practical activities. Students will answer the following questions.

Sample test to be administered to randomly sample students in groups for continuous data.
Chapter 7 Page 123-153

Topic: Magnetic Effect of an Electromagnet Current
1 Draw a magnetic field pattern around a circular coil………………2 marks
2 A small electromagnet, used for lifting and then releasing a small steel ball, is made in the laboratory as shown in the Figure below.

\[\text{Diagram of an electromagnet with core, switch, and steel ball.}\]

a) Explain why soft iron is a better material than steel to use for the core?.. 10Marks

b) In order to lift a slightly larger ball, it is necessary to make stronger a electromagnet. State two ways in which the electromagnet could be made more powerful.

\[\text{State two ways... 20Marks}\]

3 The figure below shows a rectangular plane coil ABCD of several turns of wire located in a magnetic field due to two poles, north and south. The coil is free to rotate on the vertical axis XY. When current is passed through the coil in the direction ABCD, the coil starts to turn and eventually come to rest. With the aid of diagrams explain:

\[\text{Diagram of a rectangular coil in a magnetic field.}\]
4 Two Aluminum foils 30cm each connected to independent power supplies, are placed 10 cm apart parallel to each other. The circuits are set for current to flow in the same direction. When the switches are closed:

a) Explain what happens to the metal foils …5 Marks

b) Increasing the magnitude of current flowing in the circuit: explain the effect on the metal foils …5 Marks

c) Repeating with current flowing in the opposite direction: explain what happens on the metal foils …20 Marks

d) Draw the magnetic field pattern for the two cases a) and c) and explain the magnetic field between the metallic strips …20 Marks
Part 2
To be completed by subject teacher to establish teachers motivation towards the subject.

Please circle the number, which represents how much of a problem student’s face in the study of physics during the last three years
1= Strongly Agree 2= Agree 3=Neutral 4=Disagree 5= Strongly disagree  

**KEY**

**Question 1**  Teaching and learning of Physics should be conducted by both theory and experiment  
1 2 3 4 5

**Question 2**  The school has acquired most Physics faculties for teaching and learning the subject  
1 2 3 4 5

**Question 3**  The laboratory is well equipment with other Physic apparatus for experiments  
1 2 3 4 5

**Question 4**  The laboratory assistant is very supportive in explaining the experiment and demonstration of the  
1 2 3 4 5

**Question 5**  The laboratory practical experiment experiments and theory teaching of physics have improved the teaching and learning of the subject  
1 2 3 4 5

**Question 6**  Physics with experiment have made much improvement to the teaching and learning the subject  
1 2 3 4 5

**Question 7**  The school regularly rewarded the best student and teacher in physics performance  
1 2 3 4 5

**Question 8**  The enrolment for Physics has improved in the last five years  
1 2 3 4 5

**Question 9**  Physics performance at KCSE is encouraging for the last three years  
1 2 3 4 5

**Question 10**  The teaching and learning of the subject has greatly improved and has attracted many students to choose to continue with the study of physics  
1 2 3 4 5
Question 11  The acquisition of school bus has improved the teaching and learning of physics. 

Question 12  The students have carried Physics practical with minimum support by the teachers 

Question 13  Physics is a difficult subject 

Question 14  The school regularly invites a popular physics resource person to talk to students on the subject 

Question 15  There is a large number of students taking physics as a popular subject 

Question 16  More information should be availed to both theory and practical 

   Yes No 

   ii) Practical exposure should follows theory work as soon as possible 

       Yes No 

   iii) Teacher should organize demonstration on topics where experiments is not possible 

       Yes No 

   iv) Physics teachers should retrained trained to generate experiments 

       Yes No 

   v) Technicians should be trained and employed by TSC to handle practical physics 

       Yes No
Appendix C
Observation Form

Target problems to be observed are student and teacher attitudes towards physics.
Please place a tick (✓) at appropriate behavior /item observed during teaching/discussion/learning process

<table>
<thead>
<tr>
<th>Behavior行为</th>
<th>Number of Observations 频率</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facial Expression</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Well-Equipped Laboratory</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interpersonal Space Among Students</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Absenteeism</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teacher Guiding Students during Experiment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interruption</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Speaking tone when explaining</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pronunciation Peculiarity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Verbal Vocabulary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technician Arranging Experiment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grand Total</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This Scheduled-Structured interview will be conducted; that we are interested in the kind of problems teachers and learners encounter with the study of physics in secondary schools. We need to know how the school’s administration, attitudes and career guidance support student enrolment and the study of the subject.

The following questions will be used to interview the teachers and learners.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1)</td>
<td>What is the category of your school? 1 Boy’s, 2. Girl’s 3. Mixed</td>
</tr>
<tr>
<td>2)</td>
<td>What is the school’s favorite subject?</td>
</tr>
<tr>
<td>3)</td>
<td>Does the school have a physics laboratory?</td>
</tr>
<tr>
<td>4)</td>
<td>Has the school employed a physics lab technician?</td>
</tr>
<tr>
<td>5)</td>
<td>What is the number of students enrolment for physics</td>
</tr>
<tr>
<td></td>
<td>Year 2008 2009 2010</td>
</tr>
<tr>
<td>6)</td>
<td>How many physics teachers are available in the school?</td>
</tr>
<tr>
<td>7)</td>
<td>How many students are enrolled for physics in the form three classes?</td>
</tr>
<tr>
<td></td>
<td>Years 2008 2009 2010</td>
</tr>
<tr>
<td>8)</td>
<td>What has been the students’ enrolment for physics in the last three years?</td>
</tr>
<tr>
<td></td>
<td>Years 2008= Year 2009= Year 2010=</td>
</tr>
<tr>
<td>9)</td>
<td>Has the school ever taken students or organized for physics education tours?</td>
</tr>
<tr>
<td>10)</td>
<td>In your opinion do you think physics is an important subject?</td>
</tr>
<tr>
<td></td>
<td>1 Yes 2 No 3 Others</td>
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**END**
Appendix E

Obtained data for experimental control groups

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**Code:**

1. Experimental Pretest Scores  
2. Control Pretest Score  
3. Experimental Posttest  
4. Male Experimental Posttest  
5. Female Experimental Posttest  
6. Male Experimental Pretest  
7. Female Control Pretest  
8. Male Control Pretest  
9. Female Experimental Pretest  
10. Control Posttest  
11. Male Control Posttest  
12. Female Control Posttest Scores  

*Source: Data collected by questionnaires based on pretest, treatment and posttest*
Appendix F

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*Source: Data gathered from Secondary School Records*